SOME ASPECTS OF RESPIRATORY FUNCTION IN ANAESTHETISED DOGS

by

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To

my late father

Rafique Mohammed

and to

my wife (Nahida)

for her unfailing patience

and great sacrifice.

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SUMMARY

Some respiratory and circulatory parameters were established for dogs during routine clinical anaesthesia. The possible effects on these parameters of positioning the animals in left lateral, right lateral and dorsal postures were also studied.

One hundred clinical dogs and eight experimental dogs were included in this study. The clinical dogs were categorised into two equal groups; group A, for which complete physiological and biochemical data were available and group B, for which the biochemical data were not available. All dogs were anaesthetised by a minimal dose of thiopentone sodium followed by nitrous oxide and halothane throughout the anaesthetic period.

PHYSIOLOGICAL PARAMETERS:

The respiratory and circulatory parameters which were measured were minute volume, respiratory rate and pulse rate. A review of the literature showed that a majority of the workers noted a decrease in minute volume of dogs during anaesthesia associated with a decrease in both respiratory rate and tidal volume. In man, increases in tidal volume and respiratory rate were frequently observed but the net effect on minute volume was variable, depending on the degree of change in the two components.

In this study, a significant positive corelation was found between tidal volume and body weight, and between minute volume and body weight, whilst a significant inverse corelation was established between respiratory rate and body weight.

Changes in tidal volume during anaesthesia were not significant. However, respiratory rate and in consequence minute volume showed a significant increase.

Minute volume values recorded in dorsal recumbency were found to be significantly higher than the values obtained in lateral postures. In dogs maintained in left lateral and right lateral postures respiratory rate values were comparable, but were significantly lower than the values recorded in dorsal posture. Thus the differences in the minute volume values were determined predominately by the differences observed in the respiratory rates.

Pulse rate was found to fall during the interval from ten minutes following induction of anaesthesia until the end of the anaesthetic period. No significant corelation was evident between the pulse rate and body weight or between the pulse rate values obtained in left lateral, right lateral and dorsal postures.

BIOCHEMICAL PARAMETERS:

The biochemical parameters examined were pH, P_aCO_2 and P_aO_2. A review of the literature showed that all authors found an increase in the arterial blood carbon dioxide tension with a moderate to a severe respiratory acidosis in both man and animals.

In the present study arterial carbon dioxide tension rose significantly above the preanaesthetic level, and this was associated with a considerable fall in arterial pH. The changes in the standard bicarbonate levels were not significant. The mean P_aCO_2 value recorded after sixty minutes of anaesthesia in dorsal posture was significantly higher than the mean values obtained in either of the left or right lateral postures. The fall in pH was proportionate to the retention of carbon dioxide. The mean pH values were significantly lower in dogs maintained in dorsal posture than in either of the lateral postures. The standard bicarbonate values recorded in dogs maintained in the three postures were not significantly different.

Arterial oxygen tension rose significantly above the control levels. The mean P_aO_2 values obtained in the left and right lateral postures were comparable and they were higher than those recorded in dorsal posture.

Haemoglobin concentration decreased significantly during anaesthesia, but the extent of this fall did not differ in different postures.

As a result of this investigation it is concluded that the exchange of respiratory gases is impaired in spontaneously breathing dogs under anaesthesia and the concomitant progressively developing acidosis is attributed mainly to this cause. The efficiency of ventilation is further reduced in the dorsal posture compared with the lateral.

It is recommended that the respiratory blood gases should be intermittently monitored during the anaesthesia of clinical patients, particularly those having hypoxia or acid base abnormalities as part of their clinical syndrome.

Adequate oxygenation can be maintained by administering oxygen rich mixtures with the anaesthetic gases but the elimination of carbon dioxide from those patients having high P_aCO_2 levels will require the animals to be artificially ventilated.

It is suggested that the component of respiration most requiring supplementing is the tidal volume, an increase of rate by itself having been shown in the clinical cases which were breathing spontaneously to be inefficient as a compensatory measure.

INTRODUCTION.

Clinical surgery constitutes a substantial and important part of veterinary work, particularly in small animal practice. The humanity, safety and success with which operative surgery, with all its rapidly developing specialities, can be performed, depends on the establishment of effective anaesthesia.

Although many of the animals presented for surgery and anaesthesia are relatively healthy, there are many which are ill and some of these are in a critical condition. The management of anaesthesia for all these animals is therefore of commanding importance if their successful treatment is to be achieved.

Because respiratory and cardiovascular function is influenced by the anaesthetic agents and techniques employed and may also be influenced by the animal's posture, a knowledge of these factors, and the biochemical changes which may result could well be of critical significance.

Although there are many records on the effects of anaesthetics and other drugs on the respiratory and cardiovascular systems of experimental dogs, there are few reports of the changes which take place during clinical anaesthesia and even fewer relating to changes which may occur in different postures. In the dog, many of the normal respiratory, cardiovascular and biochemical parameters are not established, or not clearly established and very many of the variations that may occur and develop during anaesthesia are either not known or their possible significance is not understood.

This research investigation was carried out in order to establish some of the respiratory and biochemical parameters that pertain during routine clinical anaesthesia. With this basic information established, it was decided to further analyse the data to identify any effects that differences in the postures in which the dogs are maintained during anaesthesia may have on these parameters.

With more reliable information on the normal parameters and with the establishment of some of the changes that take place as anaesthesia progresses, hazards may be more clearly identified and such knowledge will lead to greater safety.

REVIEW OF LITERATURE

1.0 PHYSIOLOGICAL PARAMETERS.

1.1 TIDAL VOLUME.

1.1a Normal Values:

The establishing of normal values of tidal volume in conscious dogs is technically difficult and the results unreliable because of the inherent difficulty of achieving cooperation from the animals. In consequence, reports of studies to establish normal figures are sparse. Pickrell, Dubin and Elliot (1971), recorded a mean tidal volume of 220 ml for 39 unanaesthetised standing dogs weighing between 6·8 kg and 11·5 kg.

1.1b During Anaesthesia:

Studies of the effect of halothane on tidal volume in dogs show that the tidal volume decreases during anaesthesia and tidal volume values between 125 ml and 250 ml have been recorded in dogs weighing between 10 kg and 14 kg (Raventos, 1956).

A decrease in tidal volume during light halothane anaesthesia was reported by Hall (1957) and by Hall and Norris (1958).

Reduction of tidal volume in dogs under the action of halothane was also reported by Dobkin and Fedoruk (1961), Dobkin, Harland and Fedoruk (1961), Merkel and Eger (1963), Westhues and Fritsch (1965) and by Hall (1966).

In man, tidal volume was found to decrease in patients undergoing surgery during halothane anaesthesia (Chang, Macartney and Graves, 1957, Davine, Hamilton and Pittinger, 1958, Stephen, Lawerence, Fabian, Bourgeois-Gavardin, Dent and Gross-Kreutz, 1958 and Burnap, Galla and Vandam, 1958).

However, in a study by Black and McKane (1965) the administration of halothane to 20 children resulted in a significant reduction in mean tidal volume from 321 ml to 232 ml.

1.1c <u>Effect of Posture</u>:

The effect on tidal volume of changing body position in unanaesthetised animals has apparently not been recorded in literature. However, in man, Svanberg (1957) found that the tidal volume was somewhat larger in the sitting position than in other postures, but no difference was found in this parameter between dorsal and lateral positions.

1.2 <u>RESPIRATORY RATE</u>.

1.2a <u>Normal Values</u>:

Information regarding respiratory parameters in conscious dogs is sparse. Only recently Pickrell et al. (1971), recorded a mean respiratory rate of 24 breaths per minute in 39 unanaesthetised resting beagle dogs.

1.2b <u>During Anaesthesia</u>:

Studies of the effect of halothane on respiratory and cardiovascular function showed that in dogs the respiratory rate decreases to 15 - 25 breaths per minute (Raventos, 1956), and this finding has been supported by Krautz, Park, Truitt and Ling (1958). Hall (1957), stated that the respiratory rate remained relatively unchanged during light halothane anaesthesia and this was supported by Hall and Norris (1958), who found however, that deep halothane anaesthesia caused a decrease of approximately 40% in respiratory rate. Fisher and Jennings (1958), described the existence in horses and cattle of respiratory variations but they did not establish that these variations followed any particular pattern. Slowing of respiratory rate was observed in dogs under halothane anaesthesia by Singleton (1960), Dobkin and Fedoruk (1961) and Dobkin et al. (1961). Merkel and Eger (1963) noted a decrease in respiratory rate in dogs when the alveolar concentration of halothane was increased. A reduction in frequency of respiration during surgical anaesthesia with halothane was described by Westhues and Fritsch (1965). Hall (1966) and Elezoglou (1968), largely agree that halothane causes depression of the respiratory rate, although an occasional increase was noted by Elezoglou (1968).

In man, the respiratory rate showed a tendency to increase during halothane anaesthesia, particularly with surgical stimulation (Johnstone, 1956, Brennon, Johnstone and Hunter, 1957). A respiratory rate of 30 breaths per minute was common in patients undergoing operations under halothane anaesthesia (Bryce-Smith and O'Brien, 1956). Burns, Mushin, Organe and Robertson (1957) however, found that although there was a tendency for rapid breathing during the first half hour of halothane anaesthesia, respiration slowed to between 20 and 30 breaths per minute for the rest of the anaesthetic period.

A marked increase in respiratory rate during halothane anaesthesia was recorded by Chang et al. (1957) and by Davine et al. (1958). In 1,400 patients under light halothane anaesthesia respiratory rate remained unchanged except in some patients who showed tachypnoea (Stephen, et al., 1958).

A progressive increase in respiratory rate during halothane anaesthesia has been reported by Deutsch, Linde, Dripps and Price (1962). Weuthe, Patrick and Wood (1962) gave an account of an increase in respiratory rate from an average of 19 breaths per minute to an average of 27 breaths per minute under deep halothane anaesthesia. Black and McKane (1965), reported that the administration of halothane to 20 children resulted in a significant increase in the mean respiratory rate from 25 to 32 breaths per minute.

A marked increase in respiratory rate in 20 patients undergoing minor surgery under halothane anaesthesia was also observed by Unseld and Clauberg (1968).

1.2c Effect of Posture:

The effect, on the respiratory rate of changing the body position in unanaesthetised animals has apparently not been recorded in the literature. However, in man, Svanberg (1957) found that the respiratory frequency did not appear to be influenced by posture. In man again, the changes in respiratory rate associated with the various surgical postures as compared to the dorsal (supine) position during halothane anaesthesia were random and not significant (Wood-Smith, Horne and Nunn, 1961).

1.3 MINUTE VOLUME.

1.3a Normal Values:

References to values for minute volume in conscious dogs have not been found.

1.3b During Anaesthesia.

Decreases in minute volume of about 15% in dogs under light halothane anaesthesia and 60% under deep anaesthesia were reported by Hall et al. (1958). Reductions in minute volume under halothane anaesthesia were also described by Dobkin and Fedoruk (1961), Dobkin et al. (1961) and by Fisher (1961).

In man, minute volumes were found to decrease in patients undergoing operations under halothane anaesthesia (Bryce-Smith and O'Brien, 1956). In two series of 120 and 190 patients recorded by Chang et al. (1957), the minute volume showed only slight variation because of the increase in respiratory rate and decrease in tidal volume. Davine et al. (1958) and Deutsch et al. (1962) could not find a significant change in minute volume of their patients during halothane anaesthesia.

Holmdahl and Payne (1960), reported a steady increase in minute volume during the first 30 minutes of halothane anaesthesia and thereafter it remained constant. Black and McKane (1965) found that the administration of halothane to 20 children caused a significant decrease in mean minute volume from 8·5 litres to 7·2 litres.

1.3c <u>Effect of Posture</u>:

Svanberg (1957), showed that the minute volume of unanaesthetised sitting man was somewhat larger than in other postures, but he did not find a difference in this parameter between supine and lateral positions.

Investigations of mean values in minute volume associated with the various surgical postures when compared with dorsal position during halothane anaesthesia in man revealed that the lateral, gall bladder and Trendelenburg positions caused no appreciable change (Wood-Smith et al., 1961).

1.4 PULSE RATE.

1.4a Normal Values:

For dogs a range of pulse rates from 72 to 200 beats per minute was reported by Clark (1927), and pulse rates ranging from 80 to 100 beats per minute have recently been stated by Boddie (1969).

1.4b During Anaesthesia:

In both animals and man, there seems to be little doubt that the pulse rate decreases during anaesthesia. In dogs, Raventos (1956), recorded a reduction in pulse rate during the induction period from the range 130 - 170 to 80 - 100 beats per minute and slowing of pulse rate as the blood pressure fell is reported by Hall (1957), the decrease being about 10% (Hall and Norris, 1958). Singleton (1960), Dobkin and Fedoruk (1961), Dobkin et al. (1961) and Hughes (1973) have also reported a slowing of pulse rate during halothane anaesthesia in dogs.

Tavernor and Lees (1970) recorded an initial elevation of pulse rate in horses following induction of anaesthesia with thiopentone sodium, which slowed down after a period of 2 minutes. Mitchell and Littlejohn (1972) similarly reported an immediate steep rise of pulse rate in horses following induction with thiopentone, which subsequently returned to normal during the course of 45 minutes of anaesthesia.

A tendency towards a decrease in pulse rate in most horses and cattle during halothane anaesthesia has been recorded by Fisher and Jennings (1958). In one group of horses, Vasko (1962), recorded slowing of the pulse rate from 28 to 12 beats per minute.

In man, slowing of pulse rate has been reported by Bryce-Smith and O'Brien (1956), by Brennon et al. (1957) and by Burn et al. (1957) and rates as low as 45 beats per minute were recorded by Johnstone (1956). However, Severinghaus and Cullen (1958), observed no change in the pulse rate in man during halothane anaesthesia.

1.4c <u>Effect of Posture</u>:

The effect of postural variation on pulse rate in man was studied by Eggers, De Groot, Tanner and Leonard (1963), who found no consistent change during anaesthesia on changing the body position.

There appears to be no record of the effect of change in body position during anaesthesia in the dog. In horses however, Mitchell and Littlejohn (1972) found, in dorsal posture, a marked delay in the rate at which the pulse returned to normal compared with the lateral posture.

1.5 <u>CONCLUSION</u>.

In animals, the majority of investigators have shown that the minute volume decreases during halothane anaesthesia. This decrease in minute volume was usually due to the decrease both in the respiratory rate and in the tidal volume. Hall and Norris (1958) and Merkel and Eger (1963) are of the opinion that the magnitude of the decrease in minute volume is largely or solely dependant on the anaesthetic concentration delivered to the animal (1.3b).

In man, the majority of the reports indicate that the minute volume did not change during halothane anaesthesia. This was mostly the result of an increase in the respiratory rate while the tidal volume decreased as above (1.1b and 1.2b).

Although there is general agreement regarding the decrease in pulse rate in both animals and man during the period of halothane anaesthesia, Tavernor and Lees (1970) and Mitchell and Littlejohn (1972) are of the opinion that the pulse rate increased initially immediately following induction of anaesthesia in horses and then decreased gradually to its normal level during the maintenance period.

2.0 BIOCHEMICAL PARAMETERS.

2.1 CARBON DIOXIDE TENSION:

2.1a Normal Values:

A number of factors influence the normal values of carbon dioxide tension of animal and human blood e.g. environmental temperature, atmospheric pressure and the clinical status of the subject. A blood carbon dioxide tension ranging from 29 mmHg to 46 mmHg has been recorded for 39 unanaesthetised standing dogs (Pickrell et al., 1971), and a mean arterial blood carbon dioxide tension of 36·7 mmHg was reported by Feigl and D'Alecy (1972) in 30 healthy conscious dogs.

2.1b During Anaesthesia.

The effect of general anaesthetics, particularly halothane, on blood carbon dioxide tension has received relatively little study in veterinary clinical anaesthesia. However, in experiments carried out on dogs under halothane anaesthesia, Hall and Norris (1958), reported a moderate respiratory acidosis with blood CO_2 content raised to 44 vol per cent and deep anaesthesia caused a more severe respiratory acidosis with blood CO_2 content of 52 vol per cent.

Fisher (1961), found a rise in plasma CO_2 content of dogs, sheep, calves, cattle and horses under halothane anaesthesia. Dobkin and Fedoruk (1961) and Dobkin et al. (1961), found that a progressive respiratory acidosis occurred in dogs which were permitted to breathe spontaneously under halothane anaesthesia. During their study in dogs anaesthetised in a prone (sternal) position, Merkel and Eger (1963), observed an increase in P_aCO_2 consequent to increasing alveolar halothane concentrations which ranged from 0·55% to 1·82%.

In 7 dogs undergoing ovariohysterectomy for pyometra, Iwarson (1966), reported an increase in P_aCO_2 with values ranging from 55 mmHg to 75 mmHg under halothane anaesthesia. An increase in P_aCO_2 to a mean of 58 mmHg after two hours of halothane anaesthesia in 4 experimental horses has been reported by Hall, Gillespie and Tyler (1968), and an increase in P_aCO_2 from 37·9 to 61·2 mmHg was reported in horses by Tevik, Nelson and Lumb (1968). Gillespie, Tyler and Hall (1969) studied cardiopulmonary changes in laterally recumbant anaesthetised horses and found an increase in P_aCO_2 values ranging from 55 to 66 mmHg. Mitchell and Littlejohn (1972) recorded an increase in P_aCO_2 to 53 mmHg in the lateral position and to 58 mmHg in the dorsal position in horses anaesthetised with halothane for 45 minutes.

A moderate to severe respiratory acidosis with a mean P_aCO_2 of 81 mmHg was found in 16 experimental calves anaesthetised with halothane for 60 minutes in a dorsal position (Donawick, Hiremath and Baue, 1969).

Respiratory acidosis in cows with P_aCO_2 increasing from 42 to 98 mmHg during halothane anaesthesia was reported by Bouda and Pavlica (1970).

In man, under halothane anaesthesia in the supine position a steady increase in P_aCO_2 with a mean value of 51 mmHg was reported by Holmdahl and Payne (1960). A similar increase in P_aCO_2 after 20 minutes of anaesthesia was reported by Taylor, Scott and Donald (1964). Black and McKane (1965) found a significant rise in arterial carbon dioxide tension from a mean control value of 40·7 to a mean value of 52·6 mmHg in children anaesthetised with halothane. Studies by Graber and Markello (1965) on blood gases of patients during halothane, nitrous oxide anaesthesia revealed a slight increase in arterial carbon dioxide tension.

In patients breathing spontaneously during halothane anaesthesia, Millar and Marshall (1965) observed a highly significant increase in P_aCO_2 and Marshall (1966) recorded an increase in P_aCO_2 from 40 to 50 mmHg. Scott, Lees and Taylor (1966), in their studies on respiratory and acid-base status of 6 patients undergoing minor surgery, observed that in the supine position after 15 minutes of anaesthesia the mean P_aCO_2 increased to 55 mmHg. Unseld and Clauberg (1968) reported very slight respiratory acidosis in 20 healthy individuals under halothane anaesthesia.

2.1c <u>Effect of Posture</u>:

In animals, information regarding the effect of differing body positions is lacking. As already stated, Mitchell and Littlejohn (1972) have recorded in horses an increase in P_aCO_2 to 53 mmHg in the lateral position and to 58 mmHg in the dorsal position.

In man, however, Scott et al. (1966), found no significant change in P_aCO_2 values in patients anaesthetised in a supine position when tilted either to Trendelenburg or returned to a horizontal position. These findings were supported by Scott and Slawson (1968).

2.2 ARTERIAL PH.

2.2a Normal Values:

Values for the arterial pH of conscious dogs were recently established as being in a range from 7·405 to 7·430 (Feigl and D'Alecy, 1972).

2.2b During Anaesthesia:

In dogs anaesthetised with halothane, Hall and Norris (1958), reported a drop in pH to 7·31 under light anaesthesia and to 7·16 under deep anaesthesia. A decrease in arterial pH was also reported by Dobkin and Fedoruk (1961), Dobkin et al. (1961), Fisher (1961), Merkel and Eger (1963) and by Iwarson (1966).

In experiments carried out on 4 horses breathing spontaneously under halothane anaesthesia, a slight fall in arterial pH was reported by Hall et al. (1968) and by Gillespie et al. (1969) and a fall in pH from 7·394 to 7·288 was reported by Tevik et al. (1968). In studies during anaesthesia of horses, Mitchell and Littlejohn (1972) found that the pH fell from a mean control value of 7·415 to 7·325.

A moderate to severe fall in arterial pH to a mean of 7·19 was found in 16 experimental calves anaesthetised with halothane for 60 minutes (Donawick et al., 1969).

Respiratory acidosis in cows with the pH dropping from 7·42 to 7·17 during halothane anaesthesia was recorded by Bouda and Pavlica (1970).

In man a reduction in arterial pH from an average of 7·401 to an average of 7·276 after 20 minutes of anaesthesia was reported by Taylor et al. (1964) and administration of halothane to children caused a significant reduction in arterial pH (Black and McKane, 1965). Craber and Markello (1965), showed a slight decrease in the arterial blood pH of their patients under anaesthesia.

In patients breathing spontaneously under halothane anaesthesia Millar and Marshall (1965) recorded highly significant decreases in arterial pH. A fall in arterial pH was also reported by Scott et al. (1966).

2.2c <u>Effect of Posture</u>:

In their experimental studies in horses, Mitchell and Littlejohn (1972) found more marked acidaemia in their dorsal group of horses than in the lateral group.

In man, studies of Scott et al. (1966) on patients undergoing minor gynaecological surgery, revealed no significant change in arterial pH when patients were tilted from supine horizontal to Trendelenburg or when returned to the supine horizontal positions. These findings were supported by Scott and Slawson (1968).

2.3 <u>STANDARD BICARBONATE</u>.

2.3a <u>Normal Values</u>:

Studies to establish standard bicarbonate values in normal, conscious animals are not documented. However, a range of standard bicarbonate from 18·0 to 24·0 mEq/litre was stated by Albritton (1952) to be the normal range in dogs.

2.3b During Anaesthesia:

Dobkin and Fedoruk (1961) and Dobkin et al. (1961) indicated that no significant change in standard bicarbonate values occurred in dogs during halothane anaesthesia.

In man, insignificant changes in the standard bicarbonate levels under halothane anaesthesia have been reported by Holmdall and Payne (1960), Black and McKane (1965) and by Marshall (1966).

However, Millar and Marshall (1965) observed a highly significant fall in standard bicarbonate in spontaneously breathing patients under halothane anaesthesia, and Scott and Slawson (1968) found that the standard bicarbonate fell slowly during anaesthesia with halothane.

2.3c Effect of Posture:

The effect of changing body position on the standard bicarbonate levels in anaesthetised animals apparently has not been recorded.

In man, Scott and Slawson (1968) found no significant difference in the standard bicarbonate levels in patients anaesthetised in supine, lithotomy and Trendelenburg positions.

2.4 ARTERIAL OXYGEN TENSION.

2.4a Normal Values:

Feigl and D'Alecy (1972), determined the normal P_aO_2 values as being 89·5 mmHg in 30 dogs under normal conditions of altitude.

In 39 healthy conscious dogs, a mean P_aO_2 value of

73·7 mmHg was recorded by Pickrell et al. (1971) at an elevation of 5,500 feet.

2.4b <u>During Anaesthesia</u>:

In experimental studies on 4 horses spontaneously breathing oxygen enriched halothane mixtures, an increase in P_aO_2 was reported by Hall et al. (1968). In studies of the cardiopulmonary changes in anaesthetised spontaneously breathing horses, Gillespie et al. (1969) found no change in P_aO_2 values during the anaesthetic period.

Mitchell and Littlejohn (1972) found, in horses breathing chloroform with air, a large fall in P_aO_2 but an increase in horses, anaesthetised with halothane, spontaneously breathing an oxygen rich mixture.

In man, Graber and Markello (1965) reported a significant increase in P_aO_2 of patients breathing 33% oxygen, while patients who were breathing 25% oxygen usually had little change in their P_aO_2 level. Scott et al. (1966) observed an increase in P_aO_2 to a mean of 108 mmHg in patients anaesthetised with a halothane and nitrous oxide, oxygen mixture, (6 litres and 2 litres per minute respectively).

2.4c <u>Effect of Posture</u>:

According to Hall (1971) arterial oxygen tension in anaesthetised horses appears to depend on the size of the animal and its position during anaesthesia. P_aO_2 tends to be higher when the animal is lying on its side rather than on its back. This relationship is supported by Mitchell and Littlejohn (1972), who found a significant difference in the P_aO_2 values between dorsal and lateral positions after 45 minutes of anaesthesia despite comparable alveolar oxygen tensions in the two groups.

In dogs Katori, Amorim, Theye and Wood (1970) demonstrated desaturation of dependent pulmonary venous blood occurred at times when 99·6% oxygen was breathed and disappeared in less than one minute after a change in body position that placed the affected region superiorly in the thorax. These results are believed related to the effects of gravity on the thoracic contents that produce pleural pressures at or near zero at the dependent border of the lungs simultaneously with highly negative values at superior surfaces, resulting in a vertical gradient in size of the alveoli and terminal airways - a gradient that apparently can extend to complete collapse in the most dependent regions of the lungs.

It has further been found by Reed and Wood (1970) that the distribution of pulmonary blood follows an inverse pattern in that the ventral areas are best perfused whilst the better ventilated uppermost areas are less perfused. This mismatching of ventilation and perfusion contributes a serious factor in determining the effect of posture on the adequacy of oxygen uptake.

Kelman, Nunn, Prys-Roberts and Greenbaum (1967) demonstrated in a theoretical study that appreciable reductions in arterial oxygen tension during and after anaesthesia would result from a reduction in cardiac output. They indicated that the fraction of arterial blood contributed by the pulmonary venous admixture would be depleted of oxygen because of the more sluggish systemic circulation.

positions after 45 minutes of anaesthesia despite comparable [illegible] oxygen tensions in the two groups.

In man, however, Scott et al. (1966) found no change in P_aO_2 values on tilting the patients from supine horizontal position to either Trendelenburg or returning to supine horizontal positions. Scott and Slawson (1968) observed no significant difference in the behaviour of P_aO_2 of their patients between supine horizontal, Trendelenburg and lithotomy positions.

2.5 <u>CONCLUSION</u>.

The references reviewed on the effect of anaesthesia on blood gas tension and acid-base balance indicate in man and animals a moderate to severe acidaemia occurs when spontaneous breathing is maintained. The consistant increase in the arterial carbon dioxide tension reported by all authors is indicative of respiratory acidosis.

The assessment of standard bicarbonate levels reveals that the acidaemia in the majority of cases is a consequence of respiratory acidosis, but the fall in standard bicarbonate reported by Millar and Marshall (1965), and Scott and Slawson (1968), (2.3b) suggests the occurrence of metabolic acidosis as well as respiratory acidosis in their studies.

Arterial oxygen tension was found to fall below the control levels in horses breathing air, (Mitchell and Littlejohn, 1972). In most studies made during anaesthesia, a positive effort was made to ensure adequate arterial oxygenation by supplementing the inspired gas with high oxygen and in consequence the oxygen tension values reported were dependent on and related to the inspired oxygen tension

(Craber and Markello, 1965 and Scott, et al., 1966), (2.4b).

3.0 HAEMOGLOBIN CONCENTRATION.

The effect which anaesthesia has on haemoglobin concentration and haematocrit has frequently been observed during the past 60 years. Most of the early studies are recorded in relation to ether anaesthesia, but the effect of barbiturate anaesthesia is also well documented. The changes occurring with halothane are reported only sparsly.

3.1a Changes during Ether Anaesthesia:

As early as 1916 Mann observed a slight increase in the erythrocyte count of the blood of dogs under ether anaesthesia and this finding was confirmed on rabbits by Boycott and Price-Jones (1922).

In studies of dogs during ether anaesthesia, Barbour and Bourne (1923) observed increases of 16% in erythrocytes and 10% in haemoglobin whilst Searles and Essex (1936) found increases of 15% in erythrocytes and 19% in haemoglobin.

McAllister and Gregson (1937) found an increase in the haematocrit level with reductions in plasma volume averaging 11·9% during ether anaesthesia in dogs. These changes occurred within 15 - 30 minutes of the start of anaesthesia and prolongation of anaesthesia to 2 hours did not effect further decrease in plasma volume. Bollman, Svirbely and Mann (1938) showed in dogs lightly anaesthetised with ether, a definite increase in the haematocrit values and a decrease in the total plasma volume. Jarcho (1942) found marked haemoconcentration following administration of ether to 5 dogs which were anaesthetised with pentobarbitone.

3.1b Changes in the Spleen:

The role of the spleen, acting as a reservoir of variable capacity, has been studied in relation to these changes in haematocrit and haemoglobin values. Barcroft and Rothschild (1930), found that alcohol, ether and chloroform produced a contraction in the size of dogs exteriorised spleens. During ether anaesthesia the volume of the spleen was reduced to about one-half of its resting volume. Barcroft's work was supported by Bhatia and Burn (1933) who found that administration of ether to decerebrated cats produced an immediate reduction in the volume of the spleen.

With regard to the effect of barbiturates on the spleen, Bruger, Bourne and Dryer (1930) reported an increase in the volume of the spleen during phenobarbitone anaesthesia and Cook and Rose (1930) found that the volume of the spleen increased during iso-amyl barbiturate anaesthesia in cats.

3.1c Changes during Barbiturate Anaesthesia:

Regarding the effect of barbiturates on the haemoglobin concentration or haematocrit levels, Drabkin and Edwards (1924) and Weiss (1926) observed no significant change in the blood concentration of cats and dogs during anaesthesia with iso-amyl (Amytal) barbiturate and other barbiturates. Bruger et al. (1930) reported haemodilution with a fall in corpuscular volume of between 5 and 10% one hour after amytal anaesthesia. Searles and Essex (1936) found that sodium amytal administered by mouth to dogs produced haemodilution with reductions of 19·7% in the number of erythrocytes and 21·0% in the haemoglobin concentration. Bollman et al. (1938) have indicated that light amytal anaesthesia produced, with a few exceptions, a definite reduction in haematocrit values and total volume of red cells with also a definite increase in the plasma volume. Jarcho (1942) found that pentobarbitone produced a significant decrease in haematocrit values averaging 26·5% in cats and 22·9% in dogs. After 20 minutes of anaesthesia with pentobarbitone, Carr and Essex (1944), found that the haemoglobin concentration fell on average by 21% of the preanaesthetic level and by a further decrease to a total fall of 25% during the next hour.

A fall of the haematocrit from a control value of 45·8 to about 42·5 during the first hour of pentobarbitone sodium anaesthesia was observed by Nash, Davis and Woodbury (1956). The haematocrit value tended to rise slowly but could not regain the control level even at the end of 7 hours of anaesthesia. Graca and Garst (1957) found a decrease in the number of red cells of dogs anaesthetised by pentobarbitone sodium, which reached its lowest point in 30 minutes. The changes in haematocrit and haemoglobin concentration corresponded with the changes in red cell counts.

Barlow and Knott (1964) found a significant difference in haematocrit values between blood of control dogs, (40·8%) and blood of dogs collected 30 minutes after anaesthesia with pentobarbitone sodium(33·7%). In dogs anaesthetised with pentobarbitone sodium, Gilmore (1965), recorded a decrease in haematocrit level from a mean control value of

42·0% to a mean value of 35·2% at the end of one hour of anaesthesia.

In sheep anaesthetised with thiopentone sodium, O'Brien and Heath (1968) reported a significant reduction in haemoglobin concentration from a mean control value of 11·4 gm per 100 ml to a mean value of 9·0 gm per 100 ml, and in haematocrit from a mean control value of 32·4% to a mean value of 25·3% during anaesthesia.

3.1d Changes during Halothane Anaesthesia:

The effect of halothane anaesthesia on blood constituents, haematocrit and in particular haemoglobin concentration has not been fully studied in dogs.

Dobkin and Fedoruk (1961) showed no significant change in haematocrit values of dogs anaesthetised with halothane compared with the mean control value of 36% which was recorded after premedication with 5 mg perphenazine and induction with thiopentone sodium.

However, Dobkin et al. (1961), during their comparative study of the effect of chloroform and halothane on the respiratory and cardiovascular systems in dogs, have shown that there was a tendency towards lowering of haematocrit during halothane anaesthesia.

In sheep, however, O'Brien and Heath (1968), have demonstrated a significant fall in haematocrit from a mean control value of 28% to a mean value of 23% during halothane anaesthesia.

3.2 CONCLUSION.

The published evidence of the effect of barbiturates, ether and chloroform on the blood concentration of dogs and cats indicates that haemodilution occurs during barbiturate anaesthesia, while haemoconcentration takes place during ether anaesthesia. Haemodilution has been attributed to the passage of corpuscles from circulating blood into the substance of the dilated spleen and/or to the passage of extracellular fluid from the tissue spaces into the blood stream. Haemoconcentration during ether and chloroform anaesthesia in dogs and cats has been related to the splenic contraction as a result of sympathetic stimulation by ether and chloroform.

Administration of halothane, however, appears to cause haemodilution as a result of its inhibiting action on the sympathetic activity (Raventos, 1956 and O'Brien and Heath, 1968).

4.0 RELATIONSHIP BETWEEN PHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS.

4.1 Normal Relationship:

The maintenance of the normal physiological activity of the body demands an adequate supply of oxygen, together with the effective removal of carbon dioxide. Respiration promotes this function and it serves an essential role in maintaining the constancy of the reaction of the blood. The respiratory centre normally responds constantly to any slight chemical change in blood, and the factors exercising this chemical control are the oxygen and carbon dioxide tensions and the pH of the arterial blood.

The effect of these changes in the chemical composition of the blood is mediated through two distinct mechanisms acting directly on the chemo-sensitive neurons of the respiratory centre and reflexly by stimulation from the peripheral chemoreceptors. The neurons of the respiratory centre respond to changes in the arterial blood supplying this area. A rise in P_aCO_2, a fall in pH and a rise in temperature of the blood, stimulates respiration. Hypoxia has a directly depressant action on the centre, (Davenport, 1969).

The rise and fall of PCO_2 in arterial blood is the most important chemical in stimulating and depressing respiration. Carbon dioxide and the hydrogen ion concentration are, of course, closely inter-related. If the PCO_2 rises, dissociation of the carbonic acid formed by the solution of CO_2 in water leads to an increase in the hydrogen ion concentration and if the PCO_2 falls, the hydrogen ion concentration similarly decreases. The magnitude of the change in hydrogen ion concentration follows the change in PCO_2 and is determined by the buffer value of the medium in which the change takes place.

The blood and other cells of the body have a considerable ability to buffer the hydrogen ion, whereas the cerebrospinal fluid is poorly buffered. Carbon dioxide is highly soluble in water and in lipids and therefore any change in PCO_2 of the blood supplying a part is rapidly followed by a corresponding change in the PCO_2 of that part's interstitial and intracellular fluids. Consequently, the hydrogen ion concentration of interstitial and intracellular fluids is quickly altered by changes in alveolar and hence in arterial PCO_2.

Nearly half the effect on respiration of changes in PCO_2 is mediated by the influence of the latter on the hydrogen ion concentration of the interstitial fluid of the brain (Davenport, 1969). Respiratory chemoreceptors lie close to the ventral surface of the medulla and are bathed with interstitial fluid derived from cerebrospinal fluid. These sensitive chemoreceptors respond by activating the respiratory centre which in turn alters the alveolar ventilation.

The remaining effect of PCO_2 upon respiration is exerted through the action of carbon dioxide upon peripheral chemoreceptors in the carotid and aortic bodies. This stimulation has a corresponding effect to that of PCO_2 upon the central receptor system.

The peripheral chemoreceptors play a significant role in the regulation of respiration. They respond to a reduction in PO_2 by increasing the frequency with which they send impulses by different nerves to the respiratory centre. The increase in the frequency stimulates respiration so that alveolar ventilation increases. A sudden increase in arterial PO_2 to about 200 mmHg stops chemoreceptors discharging and alveolar ventilation falls by about 10%. This fall in turn causes retention of carbon dioxide and the resulting increase in P_aCO_2 stimulates respiration (Davenport, 1969).

4.2 <u>Relationship during Anaesthesia</u>:

In studying respiratory function during anaesthesia, the effect of the drugs used on the normal physiological reflexes must be considered.

Numerous studies of barbiturates have been reported. As long ago as 1936, Marshall and Rosenfield noted that a progressive reduction in response to CO_2 was associated with deepening barbiturate anaesthesia in animals. Following the administration of 5% thiopentone intravenously to dogs, breathing air, at an initial dose of 25 mg per kg body weight and subsequent intermittent doses as necessary to maintain a stable depression of the spinal reflex, Moyer and Beecher (1942) found a progressively diminishing response to CO_2 with the prolongation of anaesthesia, but only slight reduction in the response to hypoxia.

Dripps and Dumke (1943) investigated the respiratory response to thiopentone in decerebrated, unpremidicated cats and dogs. They too found a progressively diminishing response with the increasing depth of anaesthesia, while the sensitivity of the carotid and aortic chemoreceptors was increased or unchanged. Barton, Wicks and Livingstone (1946), maintained a steady moderate depth of anaesthesia with intermittent injections of 2·5% thiopentone and measured the arterial oxygen and carbon dioxide tensions. They found that 10 minutes after induction, the P_aCO_2 increased slightly but there was no fall in arterial oxygen tension. In clinical studies, Patrick and Falconer (1952), administered thiopentone sodium either by intermittent injection of 2·5% solution or by continuous 1% drip infusion. On maintaining a constant depth of anaesthesia, monitored by electroencephalogram, they found that the mean minute volume diminished as anaesthesia was prolonged and the response to stimulation by 5% CO_2 also diminished. The mean arterial CO_2 tension was only slightly raised during lighter levels of anaesthesia, indicating that the respiratory centre still retains control by normal stimuli although the threshold may be raised.

From these investigations it seems apparent that the bartiturates selectively depress the central physiological control of respiration while the peripheral (aortic and carotid body) reflex mechanism particularly continues to importantly influence the maintenance of respiration.

It is postulated that halothane depresses not only the medullary respiratory centre but also depresses impulses from ancillary, nonrhythmical, CO_2 sensitive neurons in the reticular formation which are thought to influence respiration (Fink, Ngai and Hanks, 1962 and Fink, Hanks, Ngai and Papper, 1963). Progressive depression in ventilatory response to both carbon dioxide and hydrogen ion stimulus has been reported in patients as a consequence of deepening anaesthesia with halothane, (Severinghaus and Larson, 1965).

MATERIALS AND METHODS

CLINICAL DOGS: (Appendix II, III and VI)

Respiratory data, were collected from 100 dogs being anaesthetised for the surgical procedures shown in Appendix 1[redacted] and V. Biochemical data were determined for 50 of these animals. The data thus obtained was studied by preparing two categories of results, Group A for those dogs having complete physiological and biochemical data and Group B for the remaining dogs for which biochemical data were not available.

<u>Group A</u>: Consisted of 50 dogs of various breeds, weighing from 4·5 kg to 49·0 (mean 21·9 kg) and between 2 months and 13 years of age from both sexes. No premedication was administered.

Before commencing anaesthesia, control arterial blood samples were collected, with the dogs in lateral posture, by puncturing the femoral artery, and the samples were drawn anaerobically into 2 ml syringes, the dead space of which was filled with heparin solution (5,000 units per ml). The syringes were capped immediately, well shaken, then placed in a thermos flask containing iced water to await analysis. The animal's rectal temperature was recorded at the time when each sample was collected.

Two further arterial blood samples were drawn, the first within 15 minutes of the induction of anaesthesia and a second at the termination of the operative treatment. Within 3 hours from collecting, all the blood samples were analysed for pH, P_aCO_2 and PO_2. PH was measured by pH meter type 27 with microelectrode unit type E5021, mounted by a gas monitor type PHA927b, Radiometer, Copenhagen. P_aCO_2 was determined by the equilibration method (Astrup microtonometer type AMT 1a, Radiometer, Copenhagen), described by Siggaard Anderson, Engel, Jorgensen and Astrup (1960), and by Adams, Hughes and Sykes (1968). PO_2 was measured by means of a PO_2 electrode type E044, Radiometer, Copenhagen. The PO_2 electrode was calibrated with accurately analysed gases and was checked frequently every day. The blood-gas correction factor which Adams et al. (1967) suggested be applied to P_aO_2 values to adjust them upwards to the equivalent tension of the gas phase with which the electrode was calibrated was not used. The pH electrode was calibrated with precision buffer solutions, type S1500 and S1510, Radiometer Copenhagen.

All electrodes and the microtonometer unit were connected to a water bath maintained at 37^{o}C by a thermostat. PH measurements were performed at this temperature and a Rosenthal correction was applied (Rosenthal, 1948) to adjust for the discrepancy between the body and measuring temperatures. P_aCO_2 was calculated from a Siggaard Anderson acid-base nomogram (Siggaard Andersen and Engel, 1960) and the standard bicarbonate was estimated as by convention with P_aCO_2 = 40 mmHg.

In all the animals, anaesthesia was induced by a sleeping dose of thiopentone sodium administered intravenously in either 2·5% or 5·0% solutions depending upon the weight of the animal. Dogs weighing more than 10 kg received thiopentone as 5% solution and those weighing 10 kg or less received the 2·5% solution. The dose necessary for induction of anaesthesia was in the range 10 - 20 mg per kg body weight. Within this dose range spontaneous respiration was continuous.

Each animal was intubated using an appropriate size of cuffed endotracheal tube, which was then connected to the anaesthetic apparatus as required in either a semi-closed system (Magill attachment), or a closed system incorporating a 16 oz soda lime canister (To-and-Fro). Halothane was introduced to the animal from a "Fluotec" mark 3 calibrated vaporiser, (Cyprane Ltd.), through which oxygen and nitrous oxide were delivered at equal flow rates from the apparatus. In the semi-closed system rebreathing of expired gases was minimised by delivering input flow rates of from 4 to 8 litres per minute to exceed the minute volume of the dog and for the to-and-fro system input flow rates of 2 litres per minute were added. In the majority of animals a steady plane of anaesthesia was maintained by an inspired halothane concentration of 1·5 to 2·0%.

Respiratory parameters and pulse rate were measured every 10 minutes from the induction of anaesthesia. Respiratory rates were counted for one minute, while minute volume was measured by a Wright's respirometer intermittently interposed between the endotracheal tube and the expiratory valve of the anaesthetic apparatus. Tidal volume was calculated by dividing the minute volume by the respiratory rate. Pulse rate was counted for one minute either from the femoral or facial arteries.

Group B: The dogs' weights in this group varied from 4·5 kg to 42·2 kg (mean 19·8 kg) and they were between 6 months and 15 years of age and of both sexes (Appendix V).

Blood gas and acid-base studies were not done in this group. Each dog was anaesthetised in a similar manner to that described for group A. Respiratory rate, minute volume and pulse rate were measured as before, every 10 minutes from the induction of anaesthesia.

EXPERIMENTAL DOGS.

Eight collies having a range of weight between 11·0 kg and 17·2 kg and of age between 6 months and 5 years, were studied. The dogs showed no clinical evidence of any respiratory or circulatory abnormalities. No premedication was given.

Each of these dogs was anaesthetised on 3 occasions with a minimum interval of one week between each trial in order to eliminate the possible residual effect of the previous anaesthesia. The protocol for each series of experiments was identical for each dog, the animal being placed in a different position on each occasion. The blood samples were collected and analysed as described for the dogs in group A.

Respiratory parameters and pulse rate were measured at 15 minute intervals from the induction of anaesthesia and anaesthesia in each case was continued for one hour.

The timing of the first blood sample during anaesthesia in the experimental dogs was after 30 minutes compared with 15 minutes in the clinical group. This time table was chosen because access to the clinical dogs after 15 minutes would have been restricted by surgical drapes and a pre-surgical value was also desirable. In the experimental dogs no such restriction was imposed.

Haemoglobin concentration was determined by the alkaline haematin method of Clegg and King (1942), using an EEL colorimeter. (The accuracy of the method has been shown to have a standard deviation of 0·14g per cent).

RESULTS

CLINICAL DOGS

5.0 PHYSIOLOGICAL PARAMETERS

5.1 TIDAL VOLUME

5.1a Changes of tidal volume over the duration of anaesthesia:

Changes in tidal volume during the course of anaesthesia are shown for group A in figure 1 and for group B in figure 2. The combined regression lines are derived from the mean intercept and the mean slope values of the regression lines calculated for each animal using the tidal volume measurements made at ten minute intervals during anaesthesia. These regression lines are prepared for the visual illustration of the relationship. For group A the data were complete whilst for group B some measurements were not available, particularly at the 50 and 60 minute times.

A decrease of tidal volume is evident as anaesthesia was prolonged. The extent of the fall as assessed by the change in the absolute values was not significant for the complete data of group A, although significant for group B, (table 1).

Table 1

Relationship of tidal volume (ml) to the duration of anaesthesia (mins) for the dogs in groups A and B.

No.of dogs	Group	Regression relationship of tidal volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
50	A	$y = 238{\cdot}33 - 0{\cdot}268\ x$	$-1{\cdot}01$	$P > 0{\cdot}05$
50	B	$y = 228{\cdot}95 - 0{\cdot}390\ x$	$-6{\cdot}76$	$P < 0{\cdot}001$

The influence of the animal's posture on the changes of tidal volume is indicated in figures 3 to 6 in which the mean values $\pm$ the standard error are plotted for each ten minute time increment. The pooled regression lines derived

Fig. 1

Behaviour of tidal volume (pooled data from 50 clinical dogs in group A) during 60 minutes of anaesthesia.

Fig. 2

Behaviour of tidal volume (pooled data from 50 clinical dogs in group B) during 60 minutes of anaesthesia.

Fig. 1

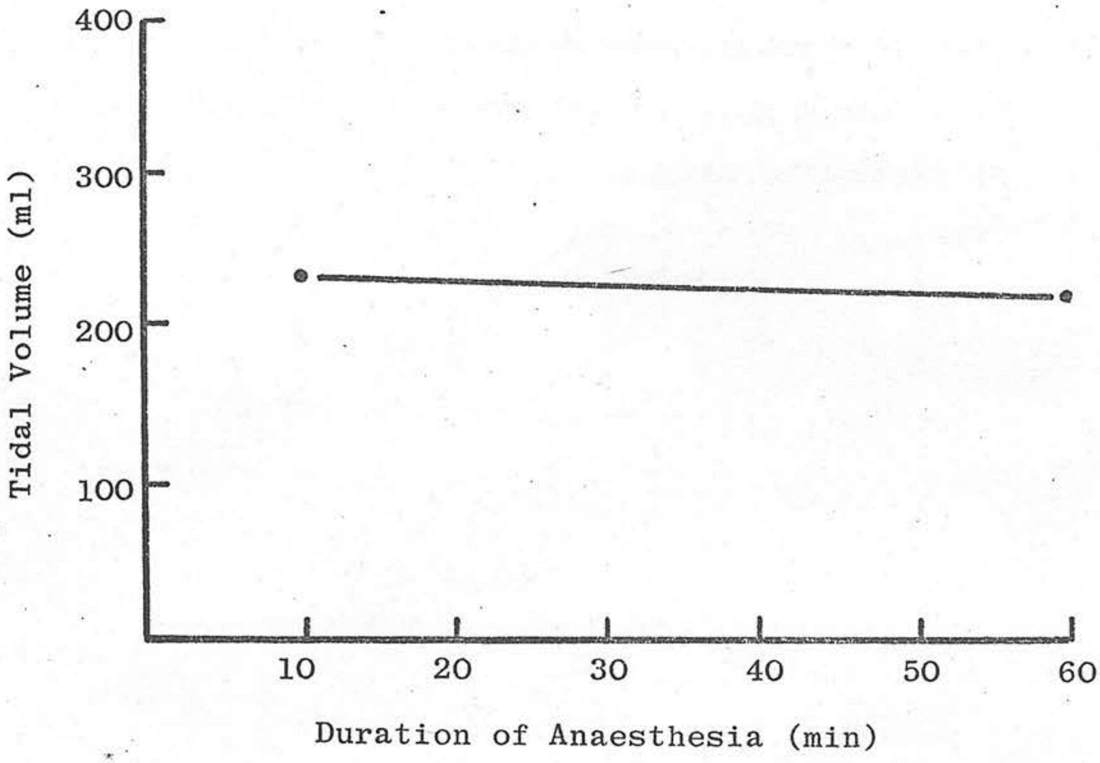

400
300
200
100
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 2

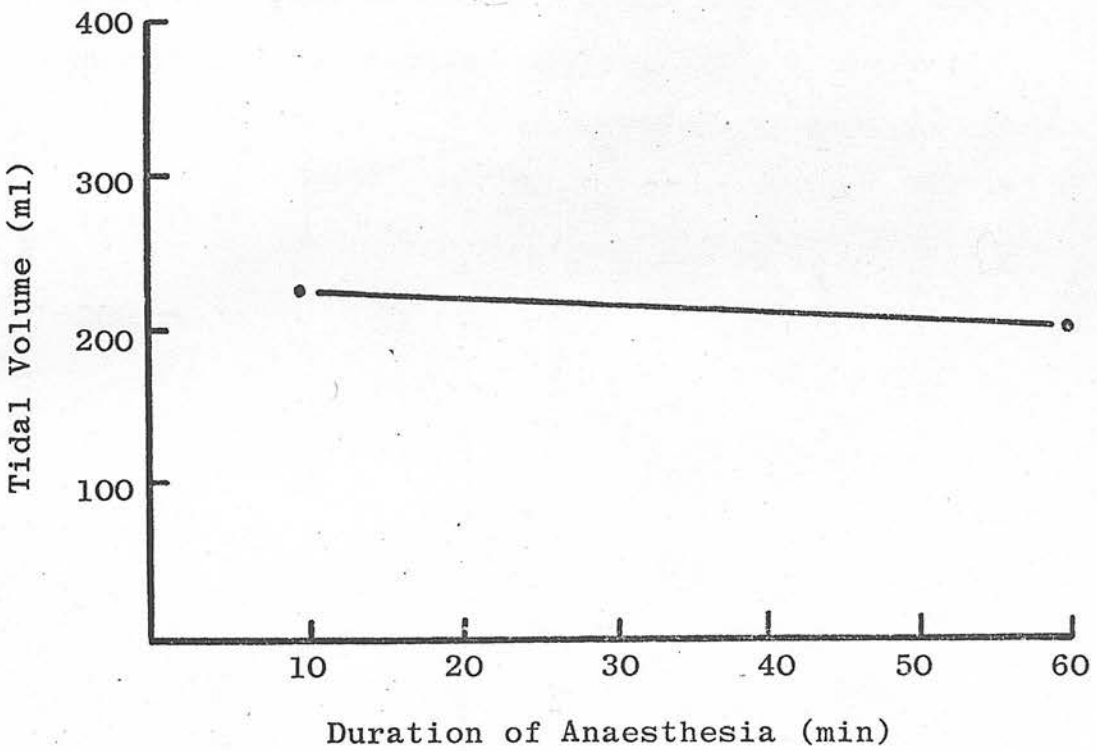

400
300
200
100
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

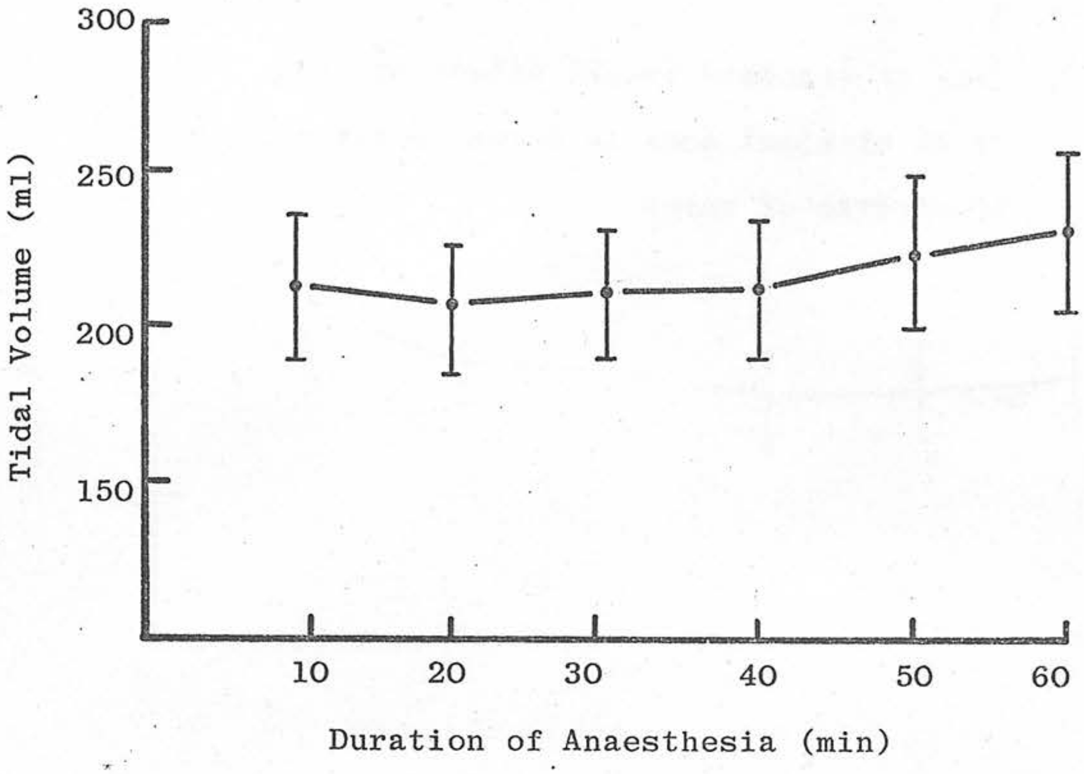
Fig. 3

Mean (± standard error) values of tidal volume of 27 clinical dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 4

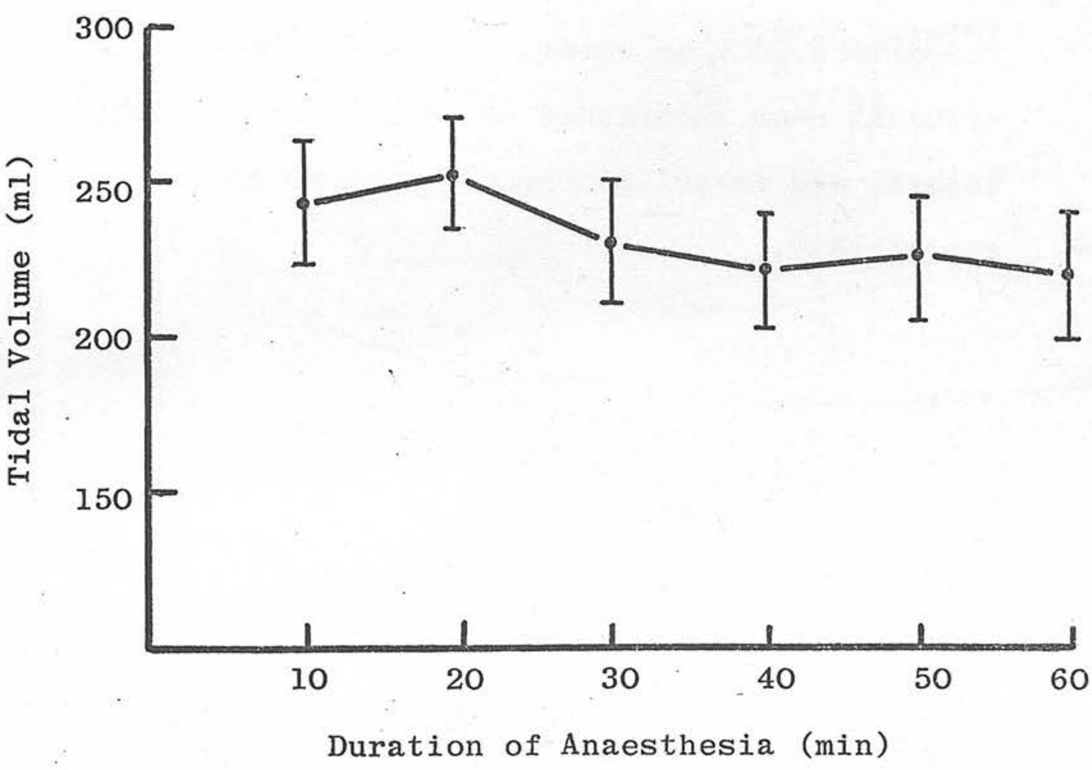
Mean (± standard error) values of tidal volume of 32 clinical dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 3



300
250
200
150
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 4



300
250
200
150
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 5

Mean (± standard error) values of tidal volume of 41 clinical dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 6

Comparison of mean values of tidal volume of 100 clinical dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 5

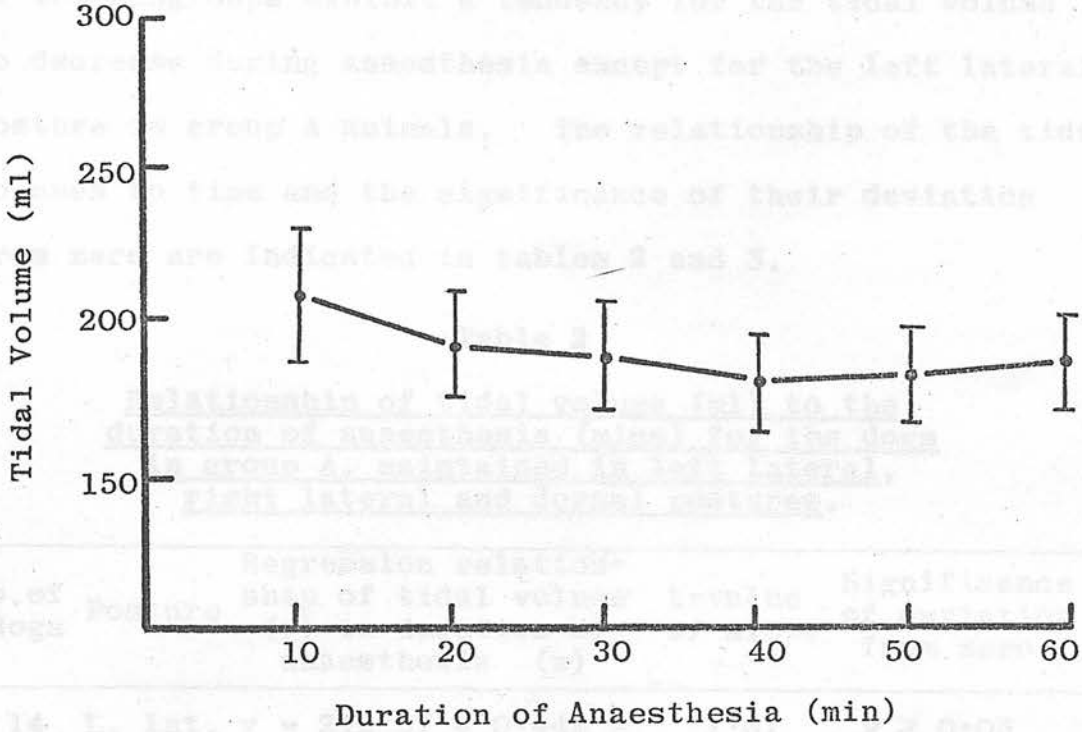
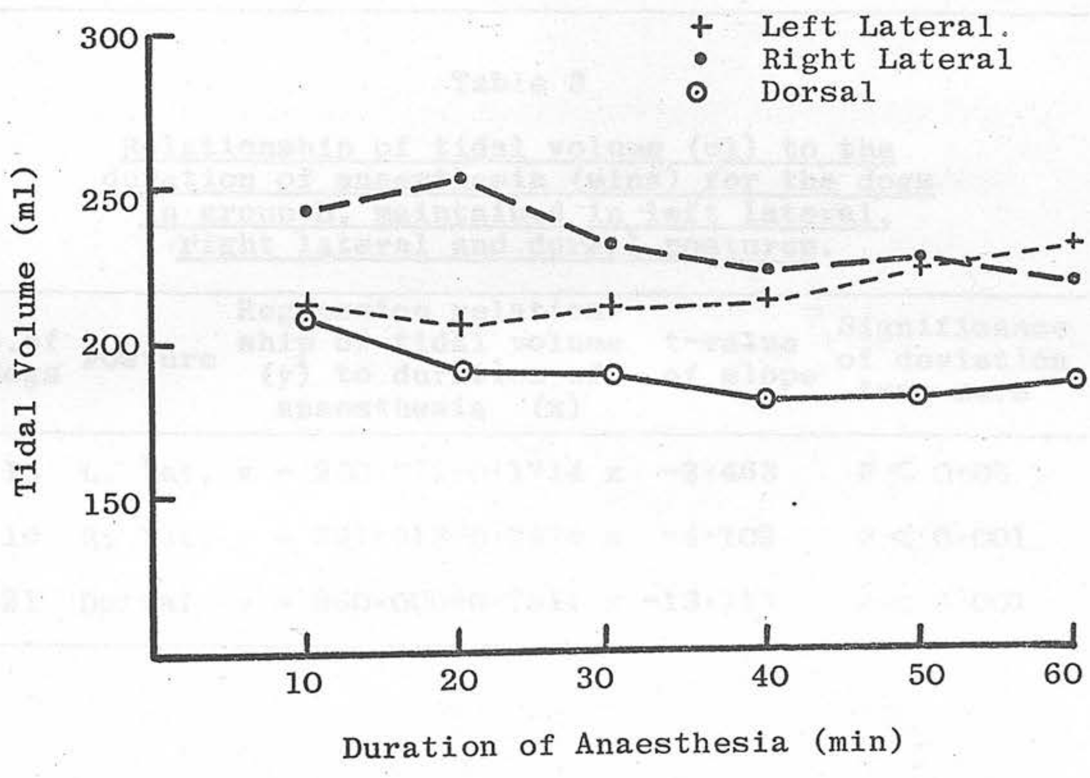

300
250
200
150
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 6


+ Left Lateral.
• Right Lateral
⊙ Dorsal
300
250
200
150
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

for each posture, as for the total number of animals in each group A and B are shown in figures 7 and 8. All of the subgroups exhibit a tendency for the tidal volume to decrease during anaesthesia except for the left lateral posture in group A animals. The relationship of the tidal volumes to time and the significance of their deviation from zero are indicated in tables 2 and 3.

Table 2

Relationship of tidal volume (ml) to the duration of anaesthesia (mins) for the dogs in group A, maintained in left lateral, right lateral and dorsal postures.

No. of dogs	Posture	Regression relationship of tidal volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
14	L. lat.	$y = 212{\cdot}57 + 0{\cdot}442\,x$	1·61	$P > 0{\cdot}05$
16	R. lat.	$y = 287{\cdot}98 - 0{\cdot}825\,x$	-1·59	$P > 0{\cdot}05$
20	Dorsal	$y = 216{\cdot}64 - 0{\cdot}321\,x$	-0·69	$P > 0{\cdot}05$

Table 3

Relationship of tidal volume (ml) to the duration of anaesthesia (mins) for the dogs in group B, maintained in left lateral, right lateral and dorsal postures.

No. of dogs	Posture	Regression relationship of tidal volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
13	L. lat.	$y = 200{\cdot}372 - 0{\cdot}1714\,x$	-2·463	$P < 0{\cdot}05$
16	R. lat.	$y = 221{\cdot}313 - 0{\cdot}2574\,x$	-4·102	$P < 0{\cdot}001$
21	Dorsal	$y = 260{\cdot}000 - 0{\cdot}7511\,x$	-13·715	$P < 0{\cdot}001$

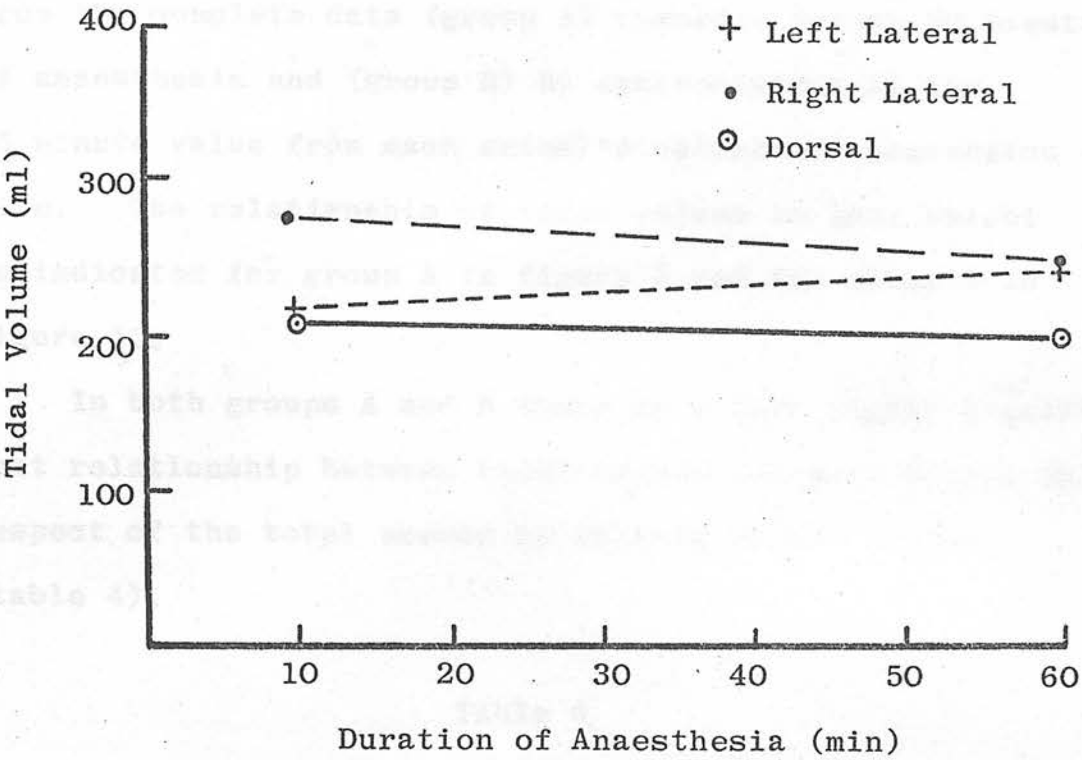
Fig. 7

Comparison of the behaviour of tidal volume of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 8

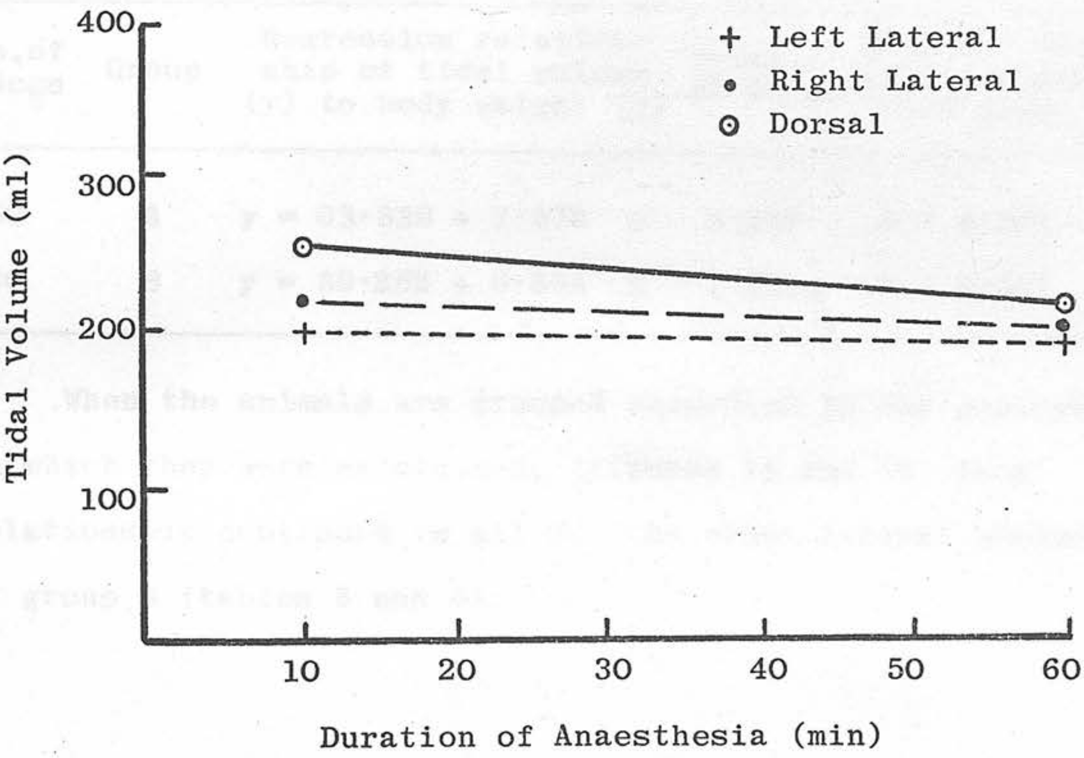
Comparison of the behaviour of tidal volume of group B dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 7



Left Lateral
Right Lateral
Dorsal
Tidal Volume (ml)
400
300
200
100
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 8



Left Lateral
Right Lateral
Dorsal
Tidal Volume (ml)
400
300
200
100
10
20
30
40
50
60
Duration of Anaesthesia (min)

5.1b Relationship between tidal volume and body weight:

For each animal a mean tidal volume was calculated from the complete data (group A) recorded during 60 minutes of anaesthesia and (group B) by extrapolation of the 35 minute value from each animal's calculated regression line. The relationship of tidal volume to body weight is indicated for group A in figure 9 and for group B in figure 10.

In both groups A and B there is a very highly significant relationship between tidal volume and body weight in respect of the total number of animals in each group (table 4).

Table 4

Relationship of tidal volume (ml) to body weight (kg) for dogs in groups A and B during anaesthesia.

No.of dogs	Group	Regression relationship of tidal volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
50	A	$y = 63{\cdot}838 + 7{\cdot}578\ x$	9·084	$P < 0{\cdot}001$
50	B	$y = 59{\cdot}262 + 6{\cdot}554\ x$	7·784	$P < 0{\cdot}001$

When the animals are grouped according to the posture in which they were maintained, (figures 11 and 12) this relationship continues in all but the right lateral posture of group B (tables 5 and 6).

Fig. 9

Relationship of tidal volume to body weight (pooled data from 50 clinical dogs in group A).

Fig. 10

Relationship of tidal volume to body weight (pooled data from 50 clinical dogs in group B).

Fig. 9

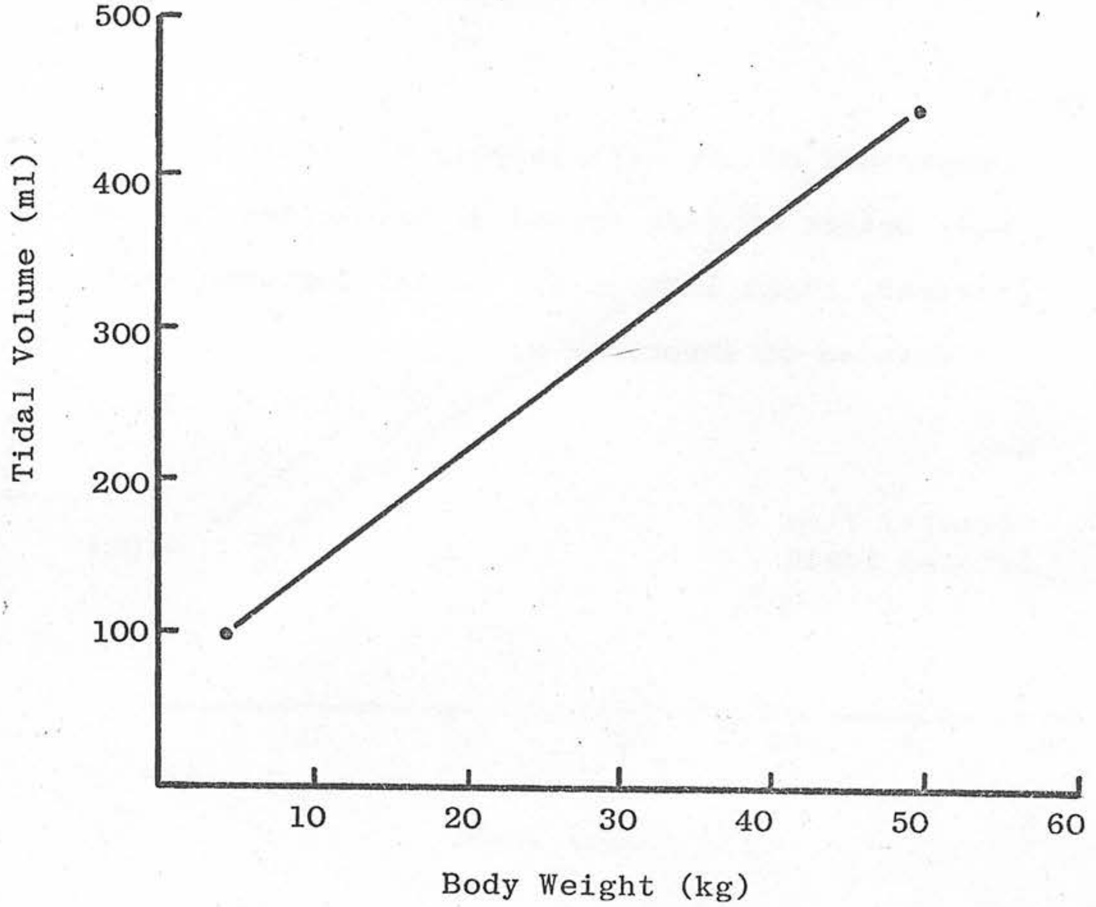

500
400
300
200
100
Tidal Volume (ml)
10
20
30
40
50
60
Body Weight (kg)

Fig. 10

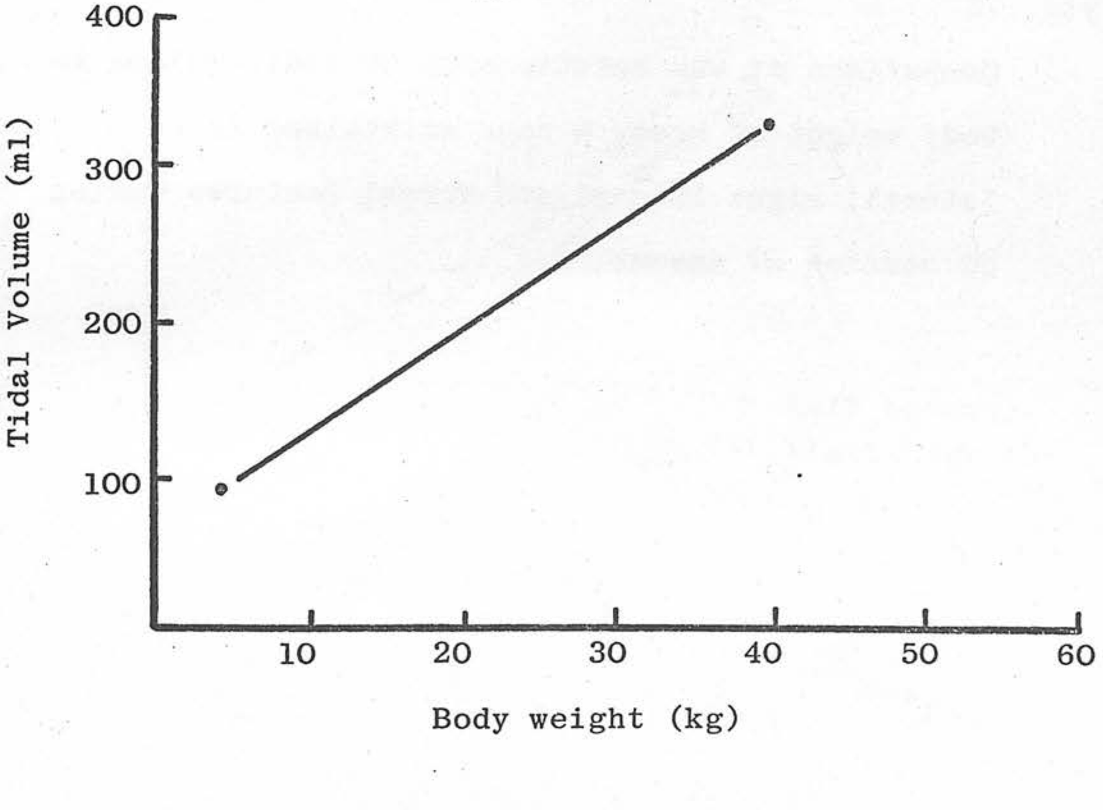

400
300
200
100
Tidal Volume (ml)
10
20
30
40
50
60
Body weight (kg)

Fig. 11

Comparison of the relationship of tidal volume to body weight of dogs (group A) maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 12

Comparison of the relationship of tidal volume to body weight of group B dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 11

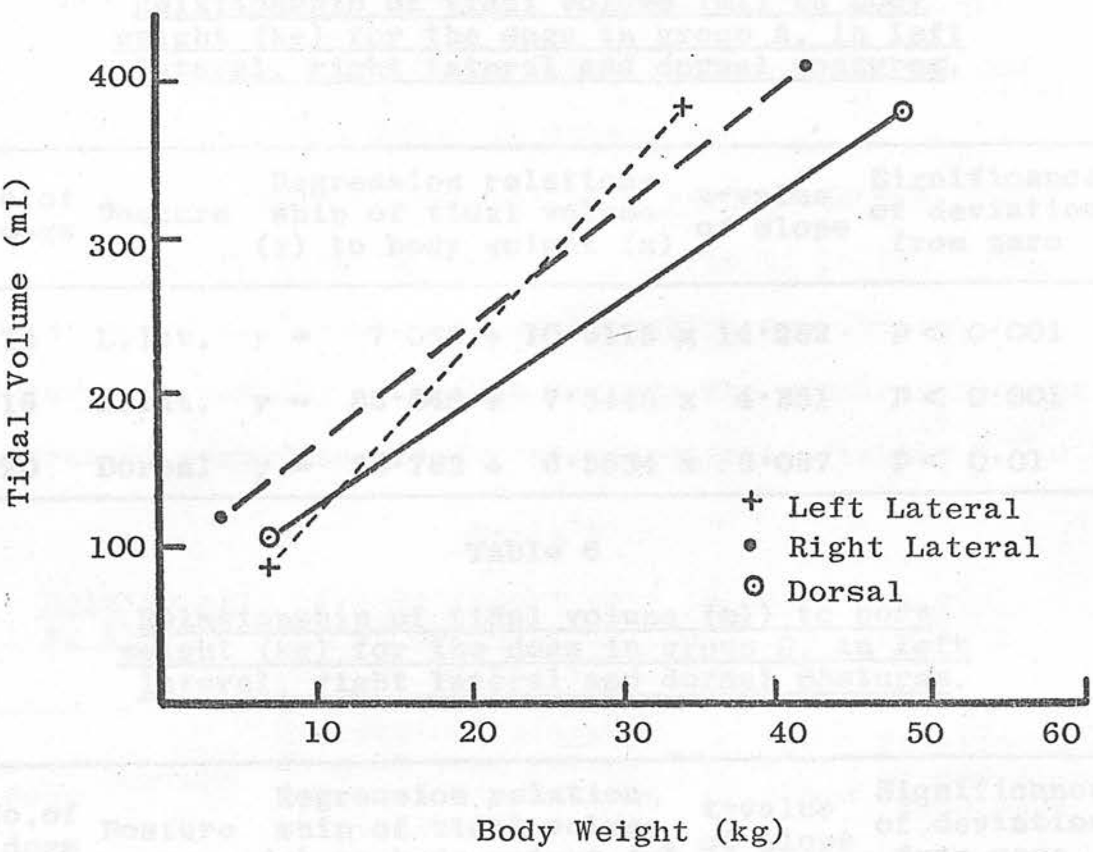

Tidal Volume (ml)
400
300
200
100
+ Left Lateral
• Right Lateral
⊙ Dorsal
10
20
30
40
50
60
Body Weight (kg)

Fig. 12

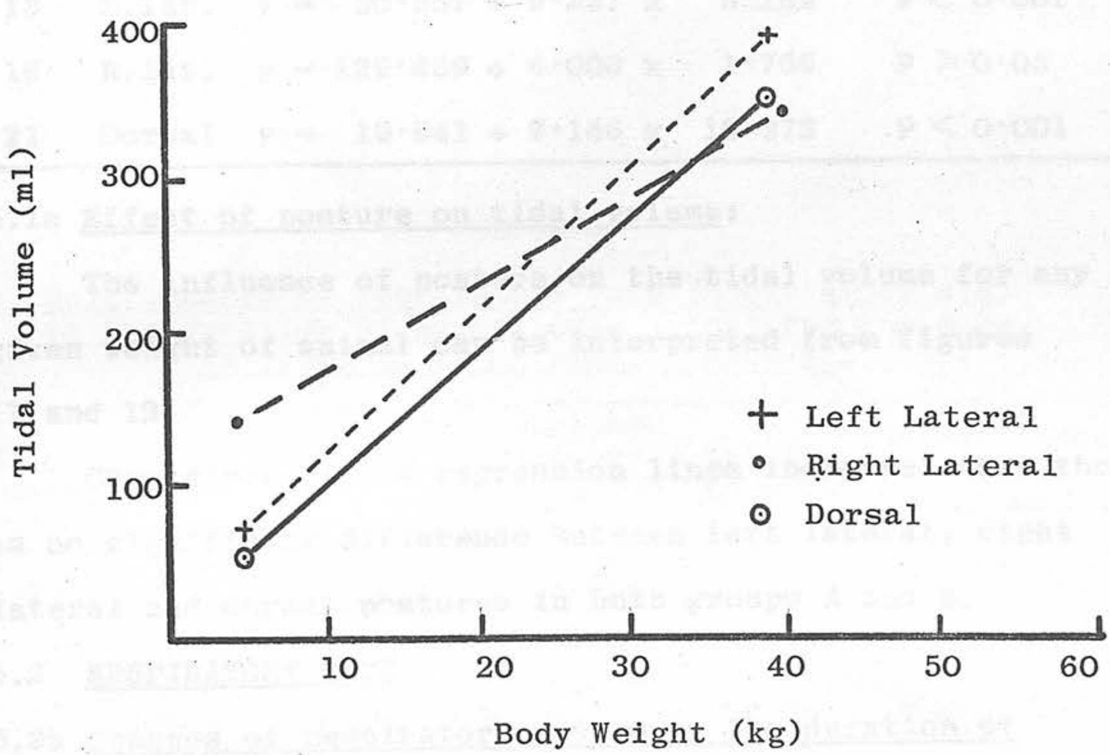

Tidal Volume (ml)
400
300
200
100
+ Left Lateral
• Right Lateral
⊙ Dorsal
10
20
30
40
50
60
Body Weight (kg)

Table 5

Relationship of tidal volume (ml) to body weight (kg) for the dogs in group A, in left lateral, right lateral and dorsal postures.

No. of dogs	Posture	Regression relationship of tidal volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
14	L.lat.	$y = 7 \cdot 055 + 10 \cdot 9115\ x$	14·282	$P < 0 \cdot 001$
16	R.lat.	$y = 88 \cdot 846 + 7 \cdot 5445\ x$	4·351	$P < 0 \cdot 001$
20	Dorsal	$y = 58 \cdot 783 + 6 \cdot 5634\ x$	3·087	$P < 0 \cdot 01$

Table 6

Relationship of tidal volume (ml) to body weight (kg) for the dogs in group B, in left lateral, right lateral and dorsal postures.

No. of dogs	Posture	Regression relation ship of tidal volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
13	L.lat.	$y = 30 \cdot 557 + 9 \cdot 227\ x$	5·785	$P < 0 \cdot 001$
16	R.lat.	$y = 129 \cdot 489 + 4 \cdot 006\ x$	1·766	$P > 0 \cdot 05$
21	Dorsal	$y = 19 \cdot 641 + 7 \cdot 146\ x$	10·372	$P < 0 \cdot 001$

5.1c Effect of posture on tidal volume:

The influence of posture on the tidal volume for any given weight of animal can be interpreted from figures 11 and 12.

Comparison of the regression lines indicates that there is no significant difference between left lateral, right lateral and dorsal postures in both groups A and B.

5.2 RESPIRATORY RATE

5.2a Changes of respiratory rate over the duration of anaesthesia:

The changes in respiratory rate occuring during anaesthesia were identified by preparing regression lines from combining the mean intercept and mean slope values calculated for each animal. The resultant lines are shown for group A (complete data) in figure 13 and for group B (incomplete data) in figure 14.

The influence of the animal's posture on the change of respiratory rate is shown in figures 15 to 18. The data pooled as regression relationships are indicated in figures 19 and 20. In each posture the respiratory rate increased significantly during anaesthesia (tables 7 and 8).

Table 7

Relationship of respiratory rate (breaths per min) to the duration of anaesthesia (mins) for the dogs in group A, in different postures.

No. of dogs	Posture	Regression relationship of respiratory rate (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
14	L. lat.	$y = 20{\cdot}030 + 0{\cdot}152\ x$	4·42	$P < 0{\cdot}001$
16	R. lat.	$y = 11{\cdot}787 + 0{\cdot}237\ x$	5·44	$P < 0{\cdot}001$
20	Dorsal	$y = 30{\cdot}836 + 0{\cdot}199\ x$	2·34	$P < 0{\cdot}05$
50	Total	$y = 21{\cdot}714 + 0{\cdot}198\ x$	5·27	$P < 0{\cdot}001$

Table 8

Relationship of respiratory rate (breaths per min) to the duration of anaesthesia (mins) for the dogs in group B, in different postures.

No. of dogs	Posture	Regression relationship of respiratory rate (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
13	L. lat.	$y = 16{\cdot}514 + 0{\cdot}2974\ x$	4·272	$P < 0{\cdot}001$
16	R. lat.	$y = 13{\cdot}483 + 0{\cdot}2696\ x$	4·297	$P < 0{\cdot}001$
21	Dorsal	$y = 20{\cdot}400 + 0{\cdot}2737\ x$	4·998	$P < 0{\cdot}001$
50	Total	$y = 17{\cdot}176 + 0{\cdot}2803\ x$	7·598	$P < 0{\cdot}001$

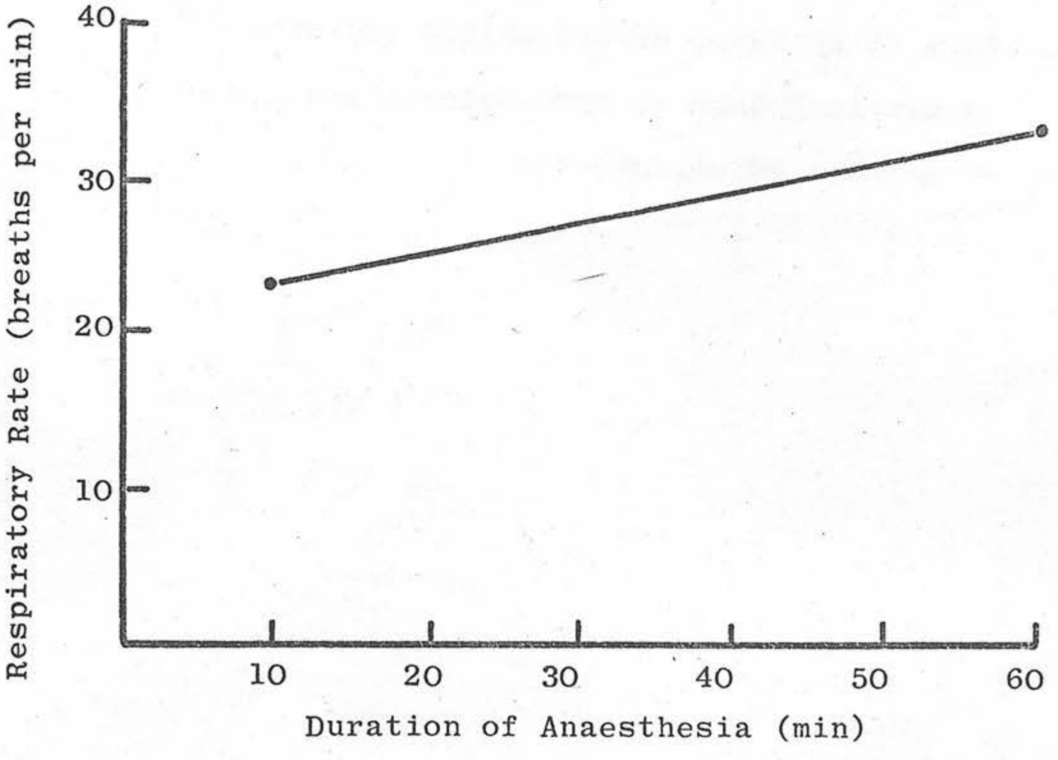
Fig. 13

Behaviour of respiratory rate (pooled data from 50 clinical dogs in group A) during 60 minutes of anaesthesia.

Fig. 14

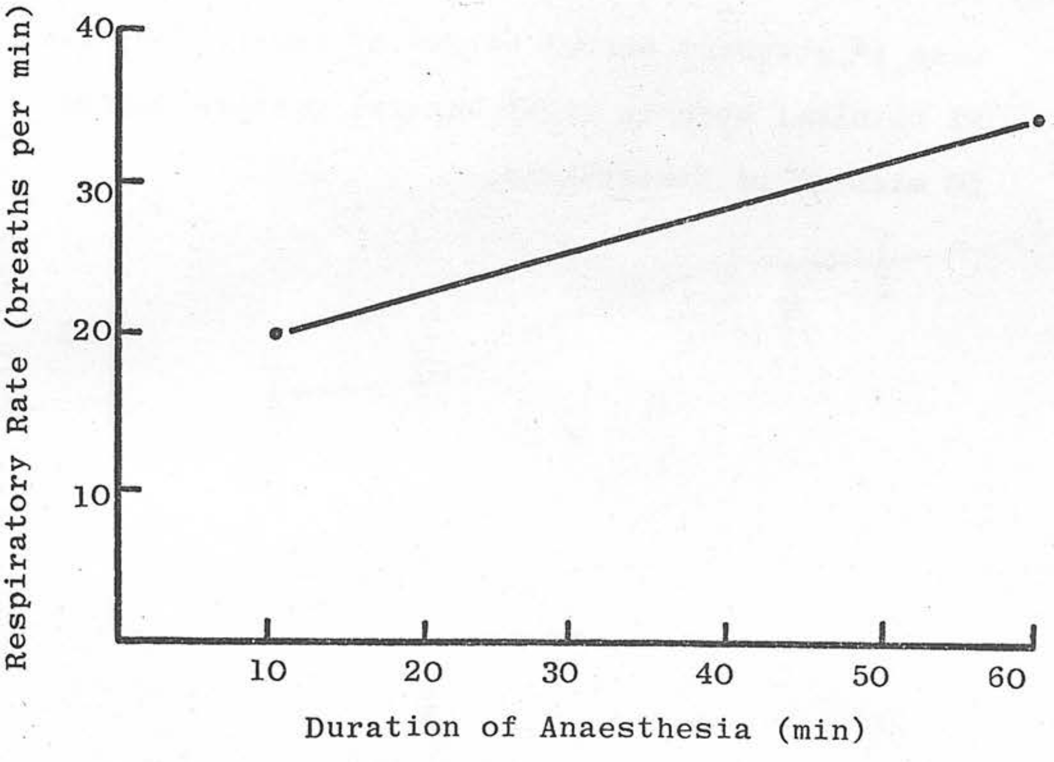
Behaviour of respiratory rate (pooled data from 50 clinical dogs in group B) during 60 minutes of anaesthesia.

Fig. 13



40
30
20
10
Respiratory Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 14



40
30
20
10
Respiratory Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

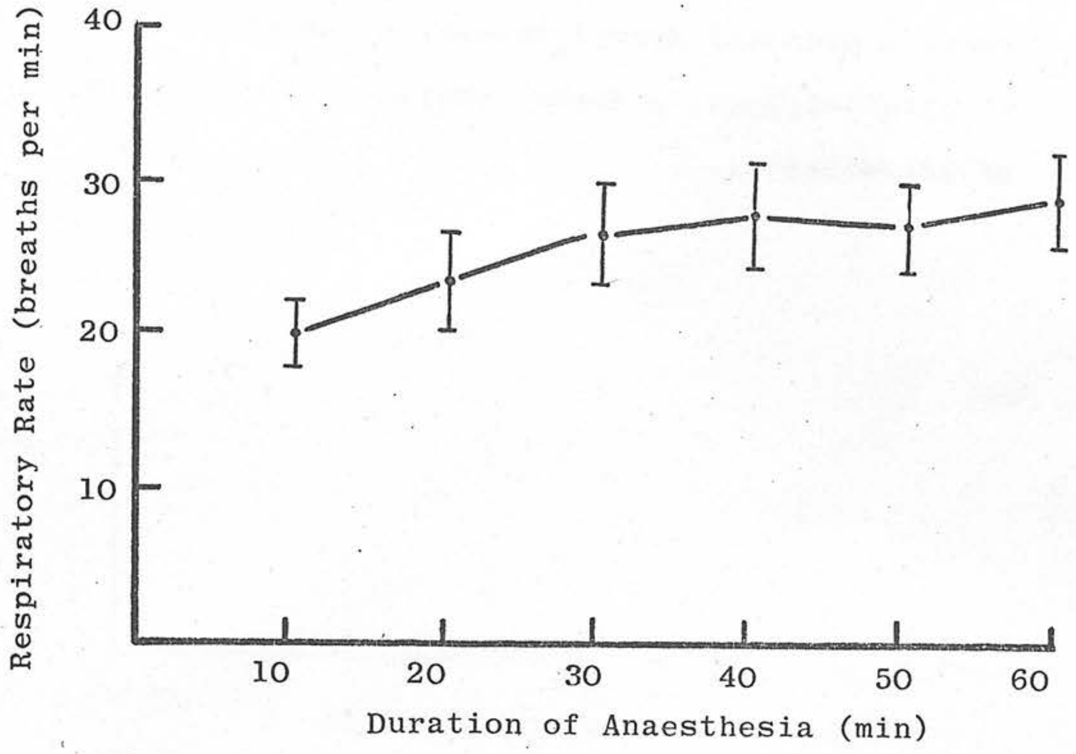
Fig. 15

Mean ($\pm$ standard error) values of respiratory rate of 27 clinical dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 16

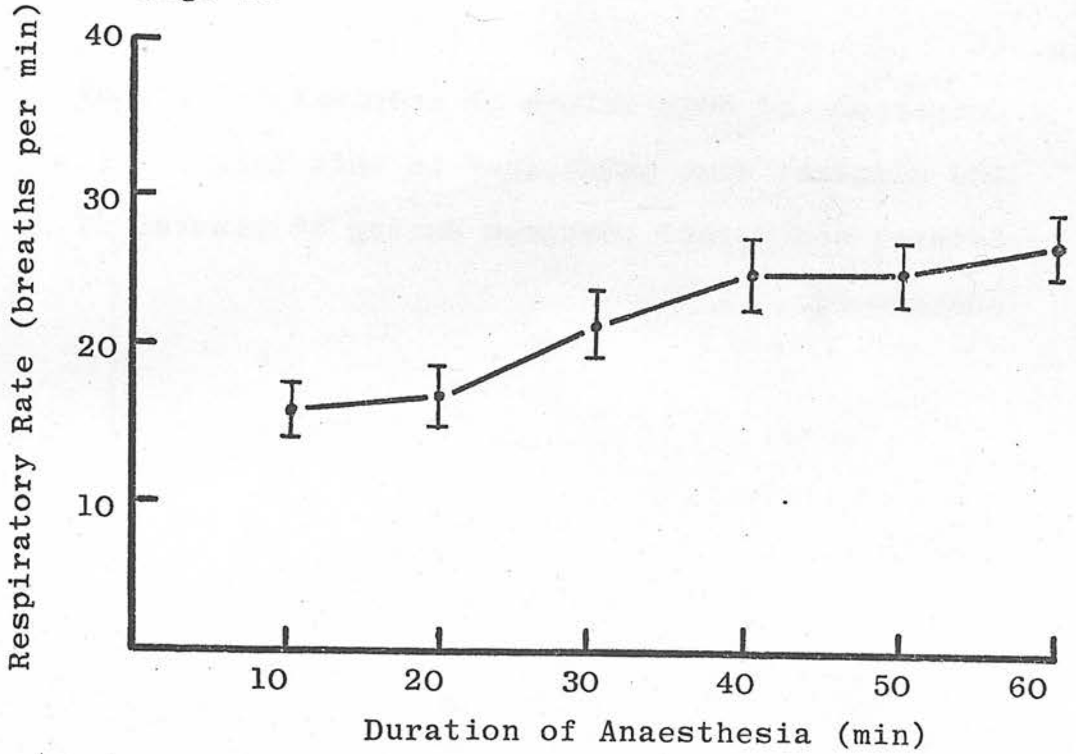
Mean ($\pm$ standard error) values of respiratory rate of 32 clinical dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 15



40
30
20
10
Respiratory Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 16



40
30
20
10
Respiratory Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 17

Mean (± standard error) values of respiratory rate of 41 clinical dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 18

Comparison of mean values of respiratory rate of 100 clinical dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 17

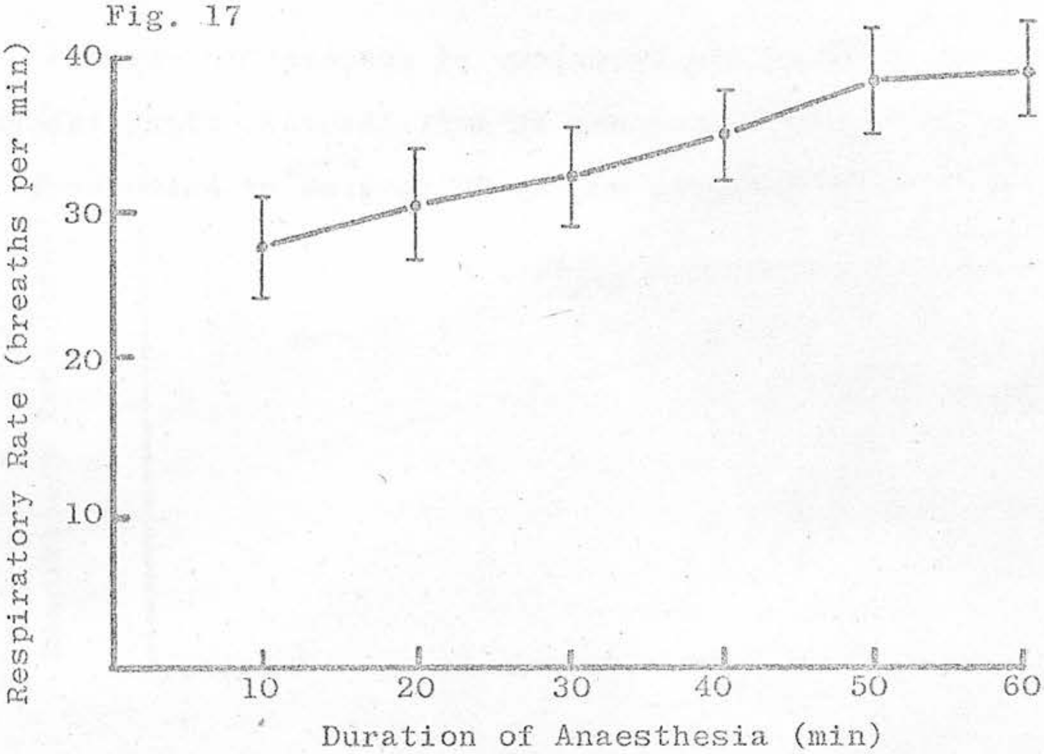

40
30
20
10
Respiratory Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 18

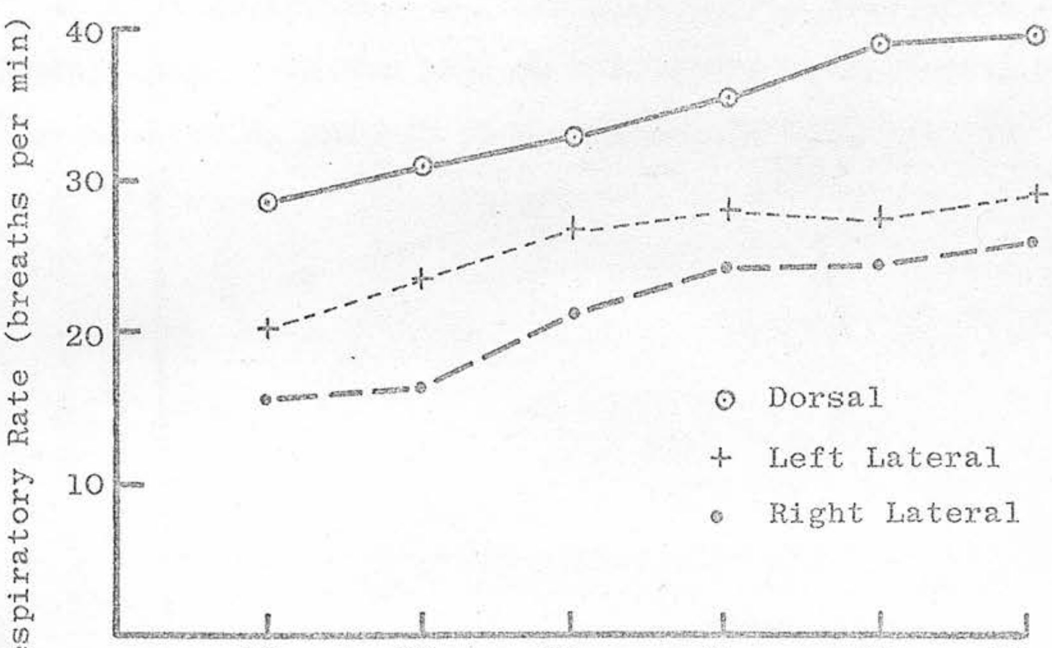

40
30
20
10
Respiratory Rate (breaths per min)
Dorsal
Left Lateral
Right Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 19

Comparison of the behaviour of respiratory rate of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 20

Comparison of the behaviour of respiratory rate of group B dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 19

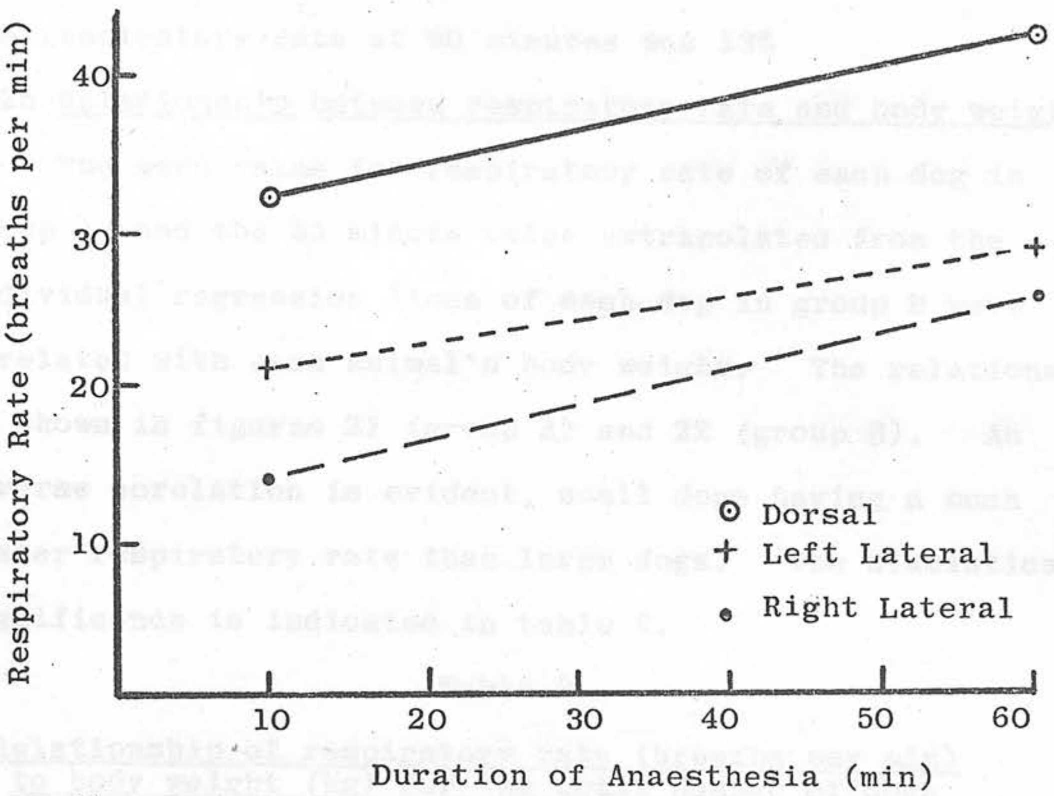
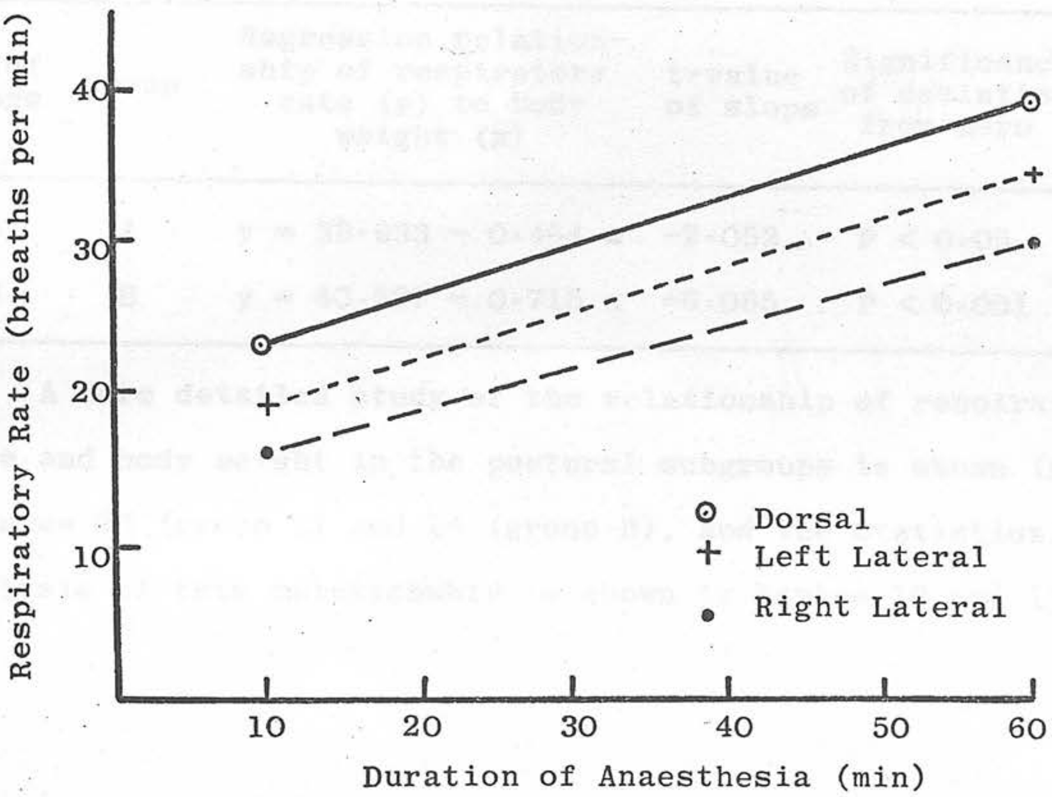

Respiratory Rate (breaths per min)
40
30
20
10
Dorsal
Left Lateral
Right Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 20


Respiratory Rate (breaths per min)
40
30
20
10
Dorsal
Left Lateral
Right Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

For the total of all the clinical dogs the increase from the mean value at the first ten minute estimate to the respiratory rate at 60 minutes was 53%

5.2b <u>Relationship between respiratory rate and body weight</u>:

The mean value for respiratory rate of each dog in group A, and the 35 minute value extrapolated from the individual regression lines of each dog in group B were corelated with each animal's body weight. The relationship is shown in figures 21 (group A) and 22 (group B). An inverse corelation is evident, small dogs having a much faster respiratory rate than large dogs. The statistical significance is indicated in table 9.

Table 9

<u>Relationship of respiratory rate (breaths per min) to body weight (kg) for the total number of dogs in groups A and B, during anaesthesia.</u>

No.of dogs	Group	Regression relationship of respiratory rate (y) to body weight (x)	t-value of slope	Significance of deviation from zero
50	A	$y = 38{\cdot}933 - 0{\cdot}464\ x$	$-2{\cdot}053$	$P < 0{\cdot}05$
50	B	$y = 40{\cdot}897 - 0{\cdot}718\ x$	$-6{\cdot}085$	$P < 0{\cdot}001$

A more detailed study of the relationship of respiratory rate and body weight in the postural subgroups is shown in figures 23 (group A) and 24 (group B), and the statistical analysis of this relationship is shown in tables 10 and 11.

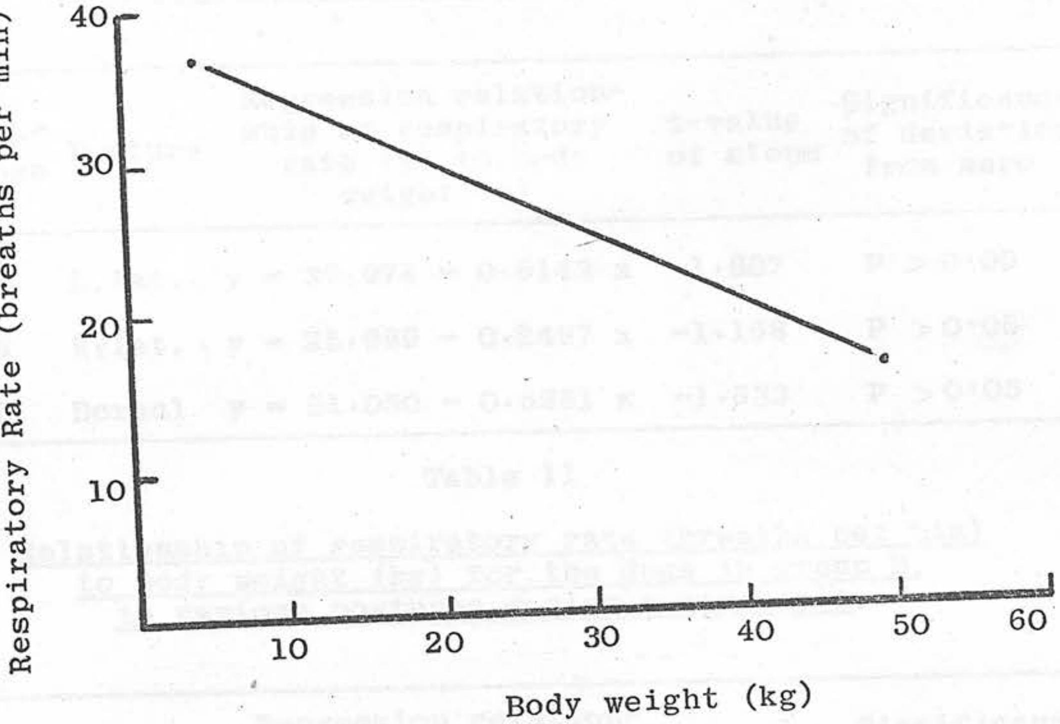
Fig. 21

Relationship of respiratory rate to body weight (pooled data from 50 clinical dogs in group A).

Fig. 22

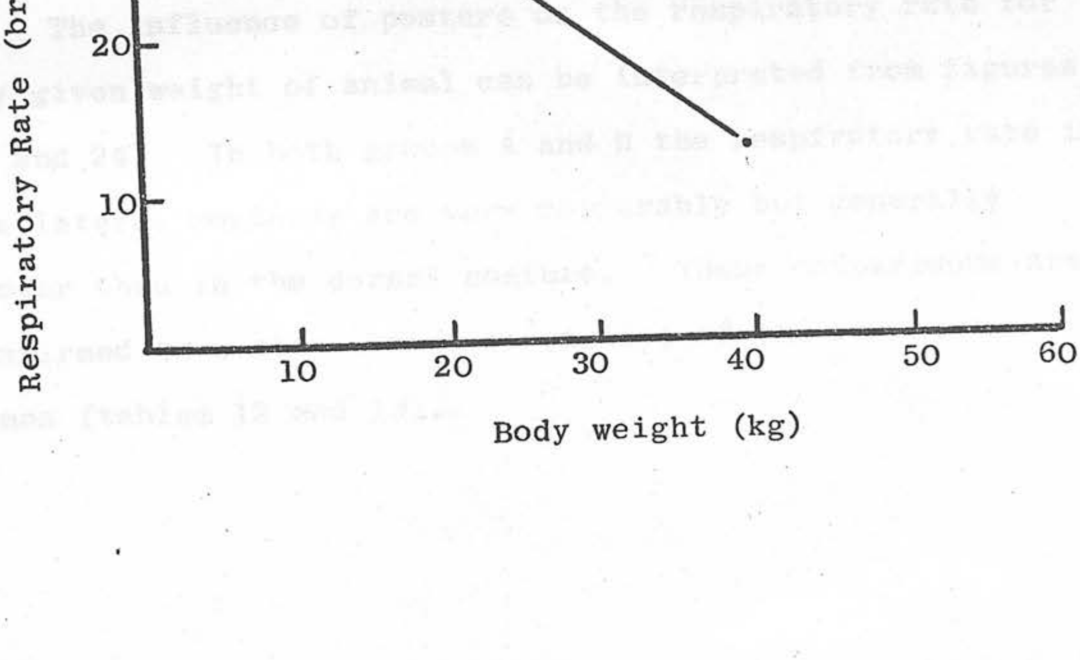
Relationship of respiratory rate to body weight (pooled data from 50 clinical dogs in group B).

Fig. 21



Respiratory Rate (breaths per min)
40
30
20
10
10
20
30
40
50
60
Body weight (kg)

Fig. 22



Respiratory Rate (breaths per min)
40
30
20
10
10
20
30
40
50
60
Body weight (kg)

Table 10

Relationship of respiratory rate (breaths per min) to body weight (kg) for the dogs in group A, in various postures during anaesthesia.

No. of dogs	Posture	Regression relationship of respiratory rate (y) to body weight (x)	t-value of slope	Significance of deviation from zero
14	L.lat.	$y = 37{\cdot}974 - 0{\cdot}6143\ x$	$-1{\cdot}807$	$P > 0{\cdot}05$
16	R.lat.	$y = 25{\cdot}999 - 0{\cdot}2497\ x$	$-1{\cdot}168$	$P > 0{\cdot}05$
20	Dorsal	$y = 51{\cdot}050 - 0{\cdot}5891\ x$	$-1{\cdot}633$	$P > 0{\cdot}05$

Table 11

Relationship of respiratory rate (breaths per min) to body weight (kg) for the dogs in group B, in various postures during anaesthesia.

No. of dogs	Posture	Regression relationship of respiratory rate (y) to body weight (x)	t-value of slope	Significance of deviation from zero
13	L.lat.	$y = 35{\cdot}906 - 0{\cdot}506\ x$	$-2{\cdot}239$	$P < 0{\cdot}05$
16	R.lat.	$y = 39{\cdot}994 - 0{\cdot}879\ x$	$-2{\cdot}248$	$P < 0{\cdot}05$
21	Dorsal	$y = 46{\cdot}297 - 0{\cdot}794\ x$	$-2{\cdot}057$	$P < 0{\cdot}05$

5.2c Effect of posture on respiratory rate:

The influence of posture on the respiratory rate for any given weight of animal can be interpreted from figures 23 and 24. In both groups A and B the respiratory rate in the lateral postures are very comparable but generally slower than in the dorsal posture. These comparisons are confirmed in a statistical comparison of the regression lines (tables 12 and 13).

Fig. 23

Comparison of the relationship of respiratory rate to body weight of dogs in group A maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 24

Comparison of the relationship of respiratory rate to body weight of dogs in group B maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 23

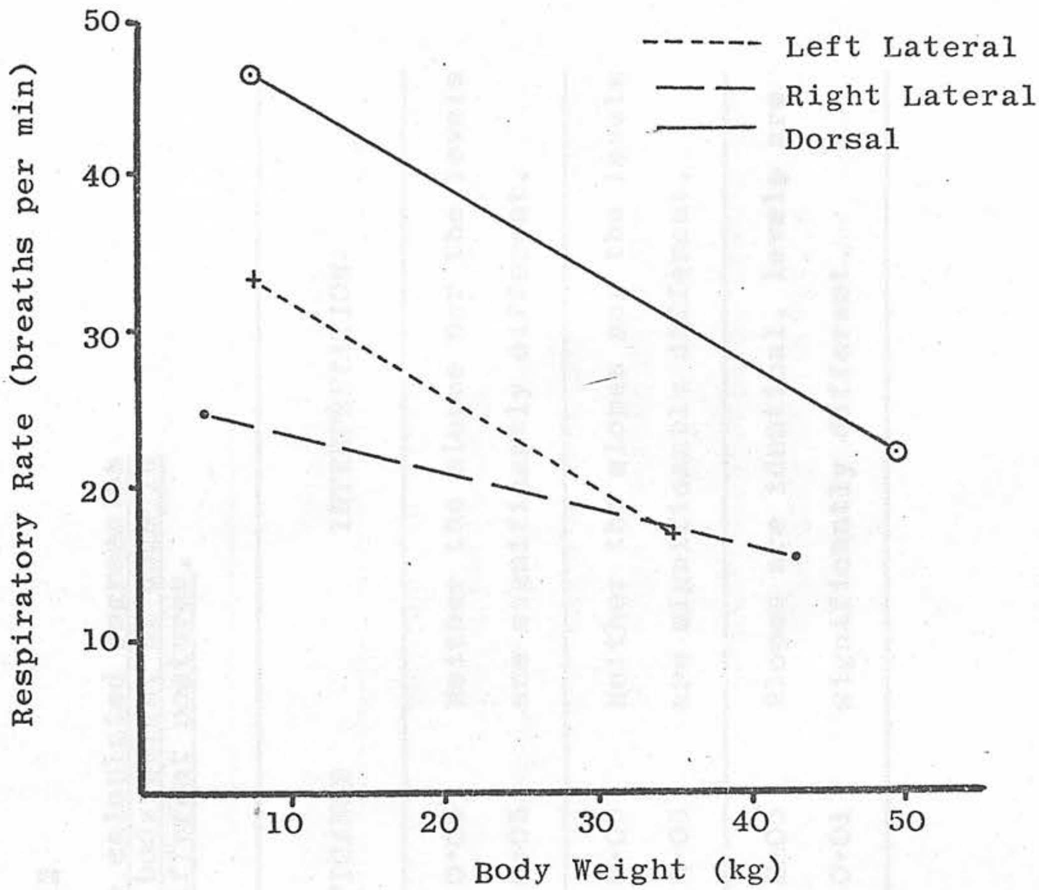

50
40
30
20
10
Respiratory Rate (breaths per min)
Left Lateral
Right Lateral
Dorsal
10
20
30
40
50
Body Weight (kg)

Fig. 24

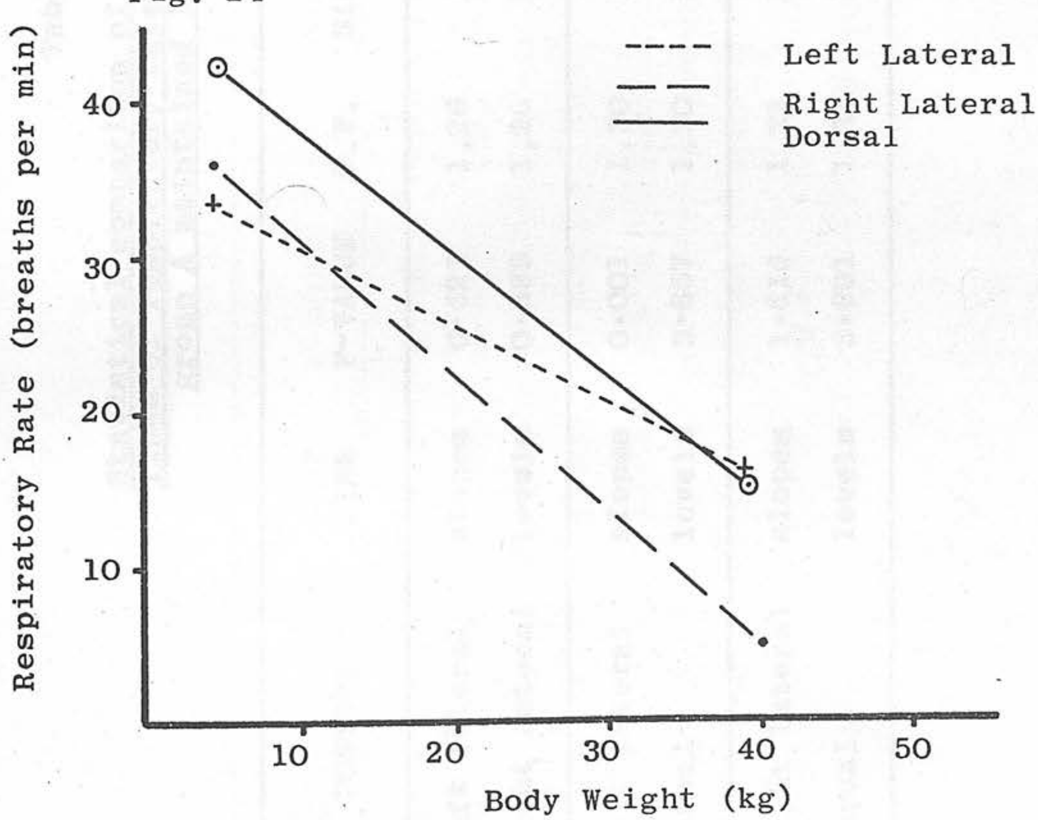

40
30
20
10
Respiratory Rate (breaths per min)
Left Lateral
Right Lateral
Dorsal
10
20
30
40
50
Body Weight (kg)

Table 12

Statistical comparison of the calculated regression lines of respiratory rate to body weight of dogs in group A maintained in different postures.

POSTURE	LINE	F-VALUE	D.F.	SIGNIFICANCE	INTERPRETATION
Left lateral	slopes	0·523	1,26	$P > 0{\cdot}05$	Neither the slopes nor the levels
Right lateral	levels	0·889	1,26	$P > 0{\cdot}05$	are significantly different.
Left lateral	slopes	0·001	1,30	$P > 0{\cdot}05$	Neither the slopes nor the levels
Dorsal	levels	3·857	1,30	$P > 0{\cdot}05$	are significantly different.
Right lateral	slopes	1·616	1,32	$P > 0{\cdot}05$	Slopes are identical, levels are
Dorsal	levels	8·901	1,32	$P < 0{\cdot}01$	significantly different.

Table 13

Statistical comparison of the regression lines of respiratory rate to body weight of dogs in group B maintained in different postures.

POSTURE	LINE	F-VALUE	D.F.	SIGNIFICANCE	INTERPRETATION
Left lateral	slopes	0·660	1,25	$P > 0{\cdot}05$	Neither the slopes nor the levels
Right lateral	levels	0·446	1,25	$P > 0{\cdot}05$	are significantly different.
Left lateral	slopes	0·424	1,30	$P > 0{\cdot}05$	Neither the slopes nor the levels
Dorsal	levels	1·270	1,30	$P > 0{\cdot}05$	are significantly different.
Right lateral	slopes	0·040	1,33	$P > 0{\cdot}05$	Slopes are identical, levels are
Dorsal	levels	4·910	1,33	$P < 0{\cdot}05$	significantly different.

5.3 MINUTE VOLUME

5.3a Changes of minute volume over the duration of anaesthesia:

The changes in minute volume during the course of anaesthesia were identified by preparing regression lines from combining the mean intercept and mean slope values calculated for each animal. The derived lines are indicated for group A (complete data) in figure 25 and for group B (incomplete data) in figure 26.

The influence of the animal's posture on the changes of minute volume is illustrated in figures 27 to 32. The data, pooled as regression relationships exhibit a tendency for the minute volume to increase during anaesthesia. The relationships of the minute volumes to time and the significance of their deviation from zero are indicated in tables 14 and 15.

Table 14

Relationship of minute volume (litres) to duration of anaesthesia (mins) for dogs in group A maintained in various postures.

No. of dogs	Posture	Regression relationship of minute volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
14	L.lat.	$y = 3 \cdot 230 + 0 \cdot 052\ x$	3·71	$P < 0 \cdot 01$
16	R.lat.	$y = 2 \cdot 743 + 0 \cdot 044\ x$	5·72	$P < 0 \cdot 001$
20	Dorsal	$y = 4 \cdot 350 + 0 \cdot 041\ x$	3·51	$P < 0 \cdot 01$
50	Total	$y = 3 \cdot 522 + 0 \cdot 045\ x$	6·96	$P < 0 \cdot 001$

Fig. 25

Behaviour of minute volume (pooled data from 50 clinical dogs in group A) during 60 minutes of anaesthesia.

Fig. 26

Behaviour of minute volume (pooled data from 50 clinical dogs in group B) during 60 minutes of anaesthesia.

Fig. 25

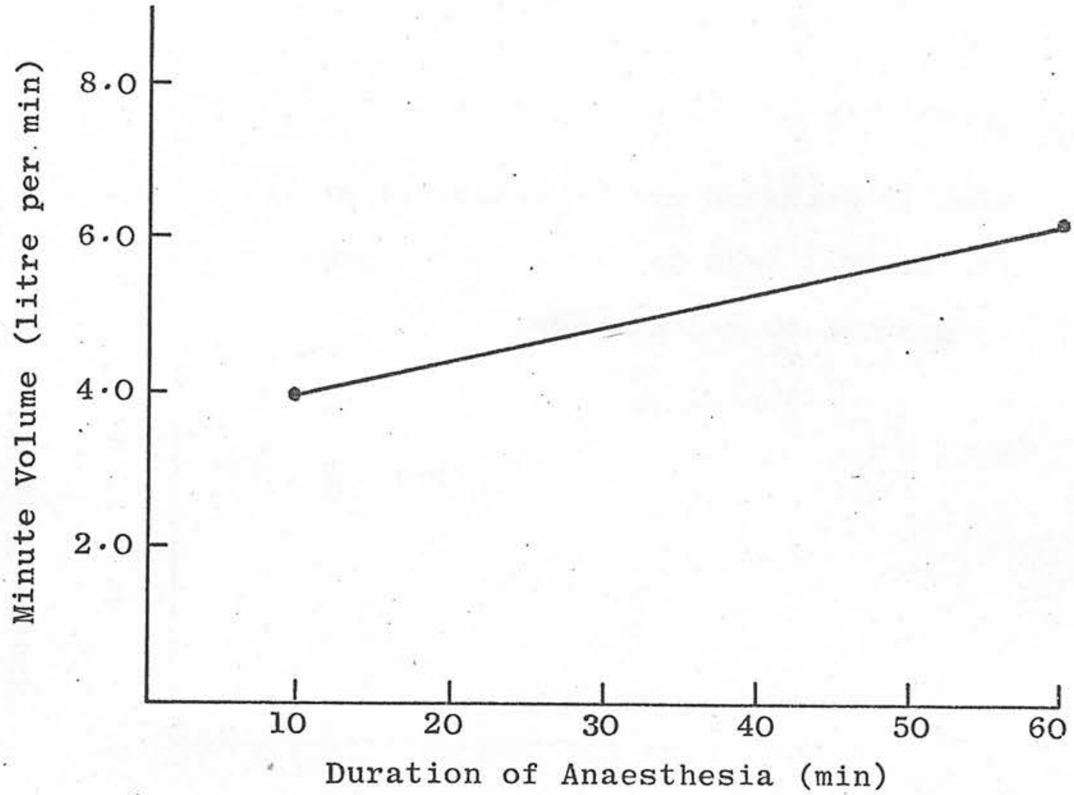

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 26

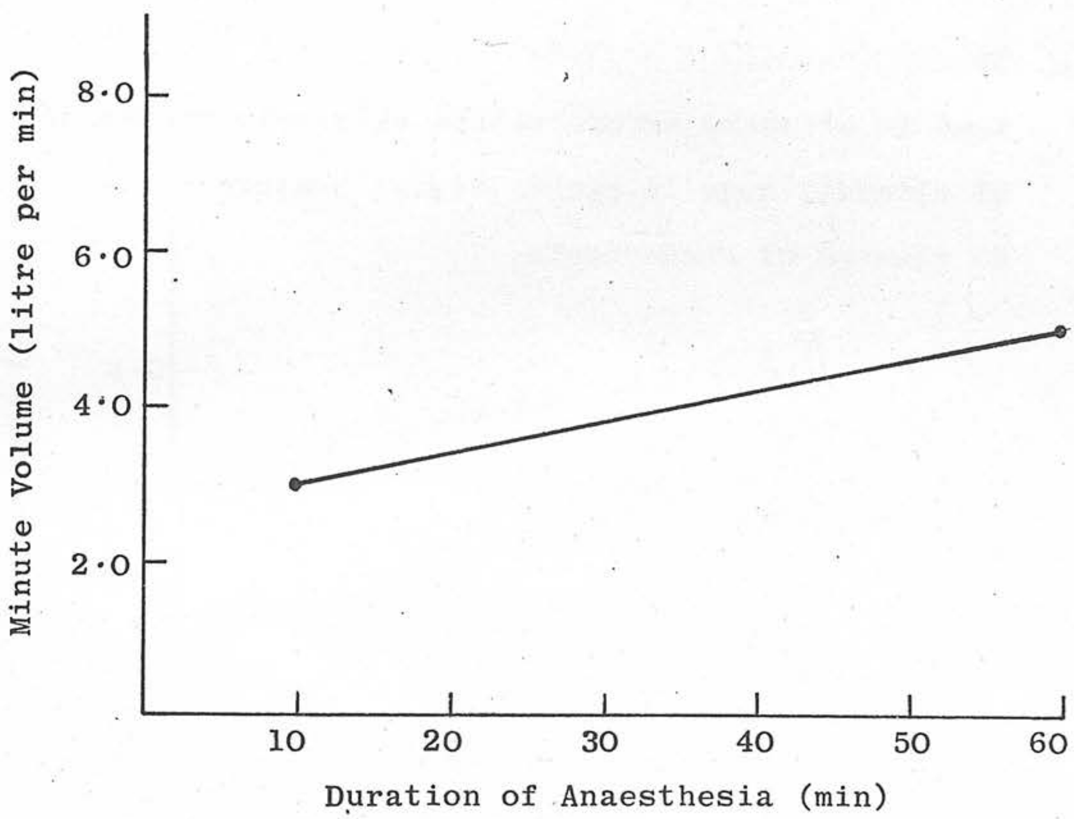

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 27

Mean (± standard error) values of minute volume of 27 clinical dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 28

Mean (± standard error) values of minute volume of 32 clinical dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 27

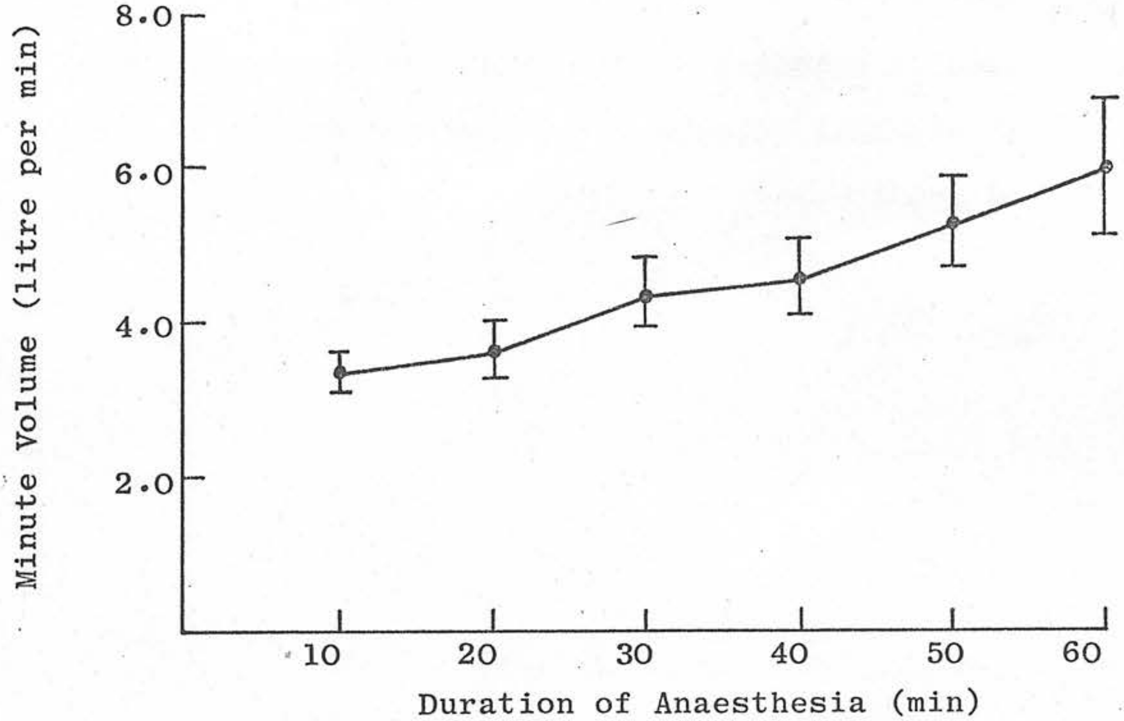

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 28

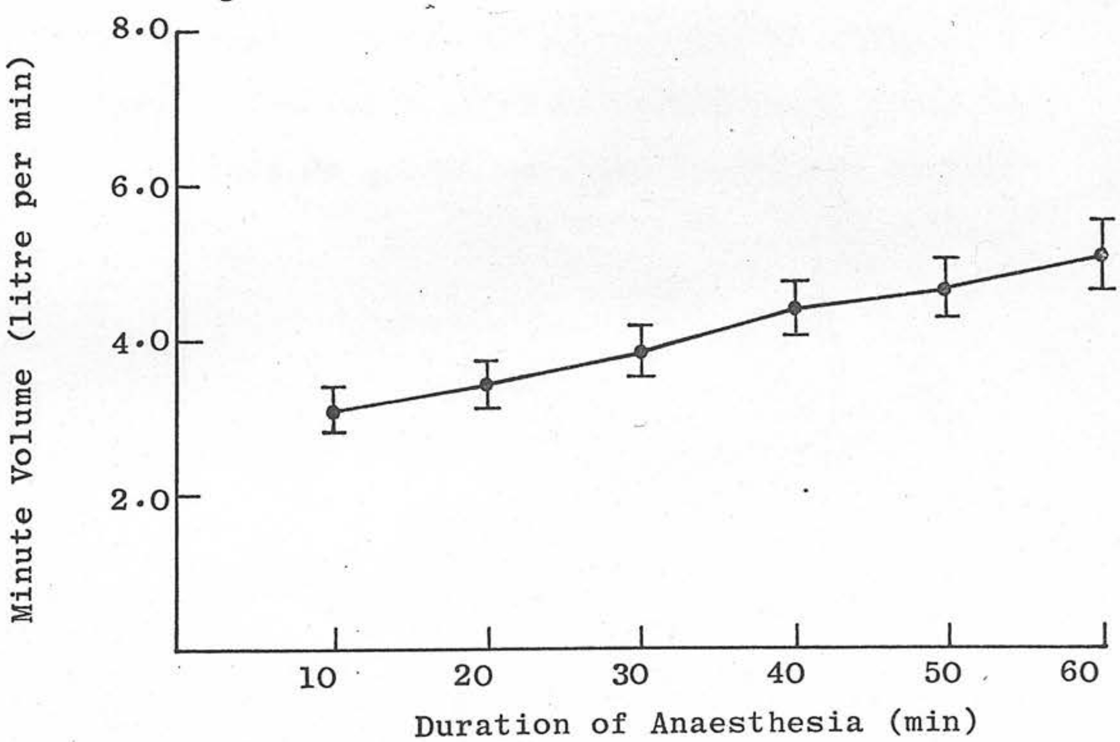

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 29

Mean (± standard error) values of minute volume of 41 clinical dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 30

Comparison of mean values of minute volume of 100 clinical dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 29

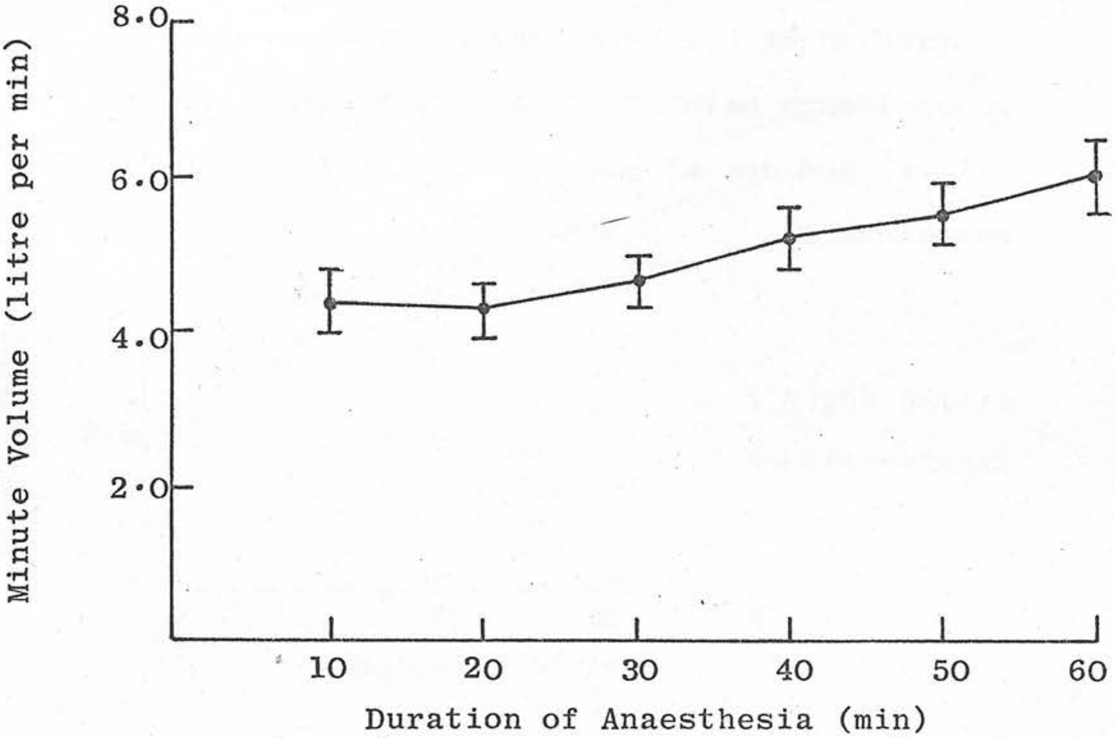

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 30

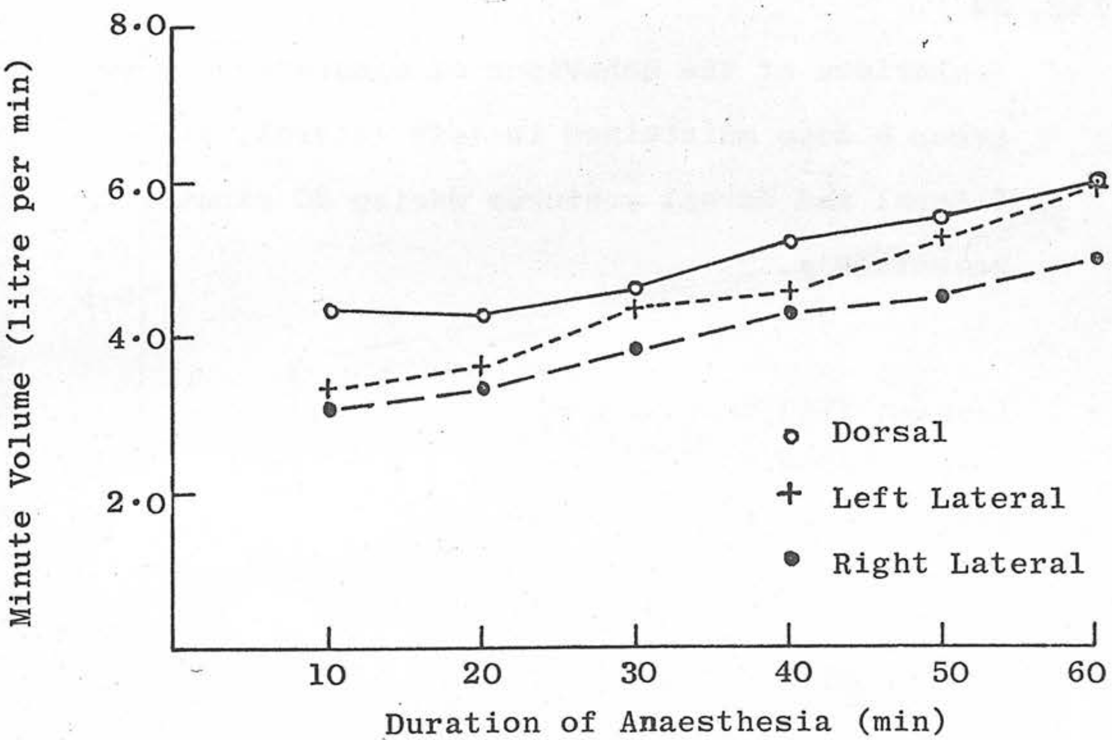

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
Dorsal
Left Lateral
Right Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 31

Comparison of the behaviour of minute volume of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 32

Comparison of the behaviour of minute volume of group B dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 31

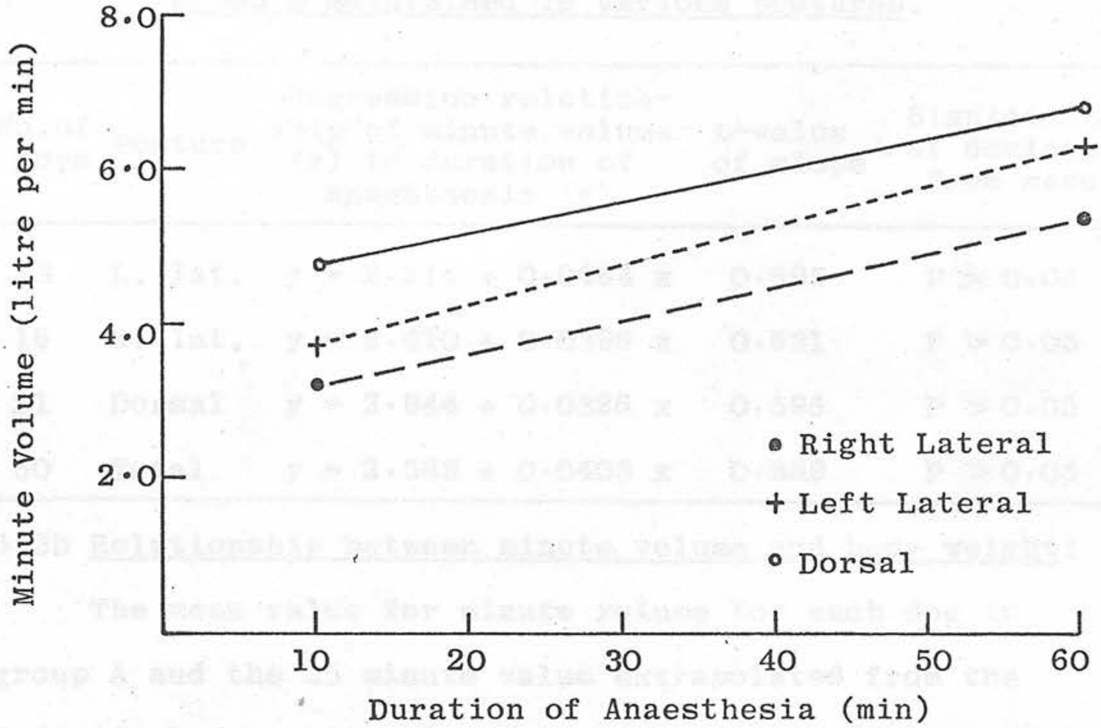

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)
Right Lateral
Left Lateral
Dorsal

Fig. 32

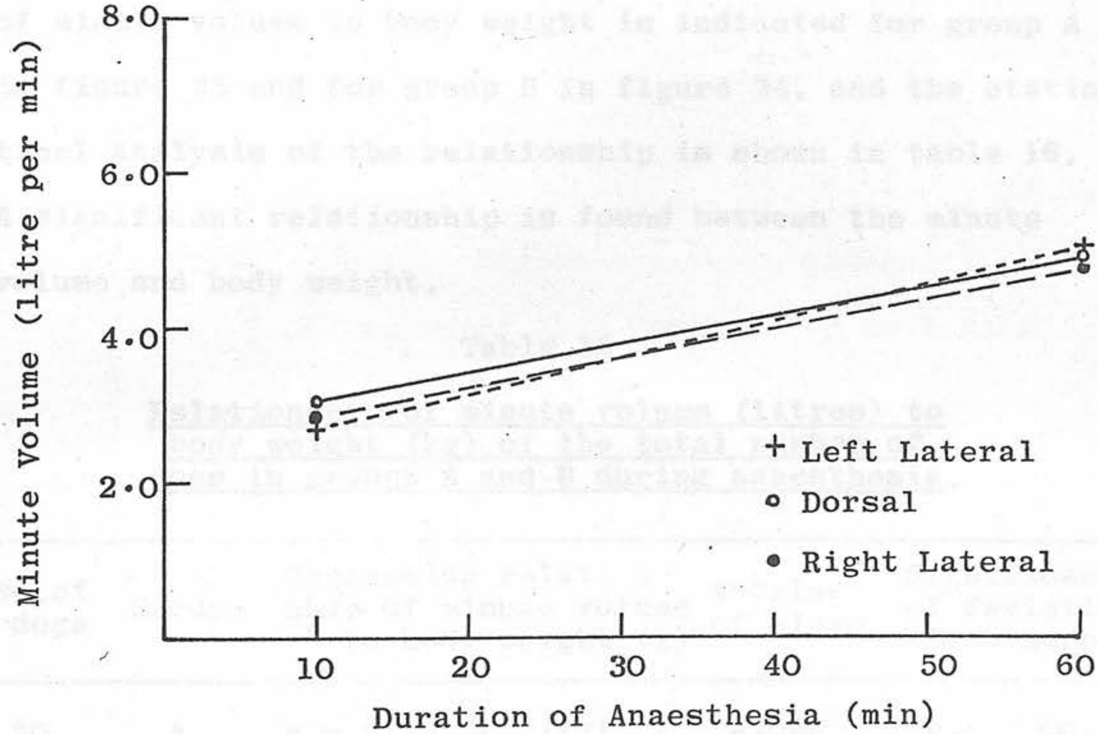

8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)
Left Lateral
Dorsal
Right Lateral

Table 15

Relationship of minute volume (litres) to duration of anaesthesia (mins) for dogs in group B maintained in various postures.

No. of dogs	Posture	Regression relationship of minute volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
13	L. lat.	$y = 2{\cdot}214 + 0{\cdot}0484\ x$	0·695	$P > 0{\cdot}05$
16	R. lat.	$y = 2{\cdot}410 + 0{\cdot}0396\ x$	0·631	$P > 0{\cdot}05$
21	Dorsal	$y = 2{\cdot}944 + 0{\cdot}0326\ x$	0·595	$P > 0{\cdot}05$
50	Total	$y = 2{\cdot}583 + 0{\cdot}0403\ x$	0·889	$P > 0{\cdot}05$

5.3b Relationship between minute volume and body weight:

The mean value for minute volume for each dog in group A and the 35 minute value extrapolated from the individual regression lines for each dog in group B were corelated with each animal's body weight. The relationship of minute volume to body weight is indicated for group A in figure 33 and for group B in figure 34, and the statistical analysis of the relationship is shown in table 16. A significant relationship is found between the minute volume and body weight.

Table 16

Relationship of minute volume (litres) to body weight (kg) of the total number of dogs in groups A and B during anaesthesia.

No. of dogs	Group	Regression relationship of minute volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
50	A	$y = 2{\cdot}261 + 0{\cdot}131\ x$	4·094	$P < 0{\cdot}001$
50	B	$y = 2{\cdot}600 + 0{\cdot}069\ x$	2·156	$P < 0{\cdot}05$

Fig. 33

Relationship of minute volume to body weight (pooled data from 50 clinical dogs in group A).

Fig. 34

Relationship of minute volume to body weight (pooled data from 50 clinical dogs in group B).

Fig. 33

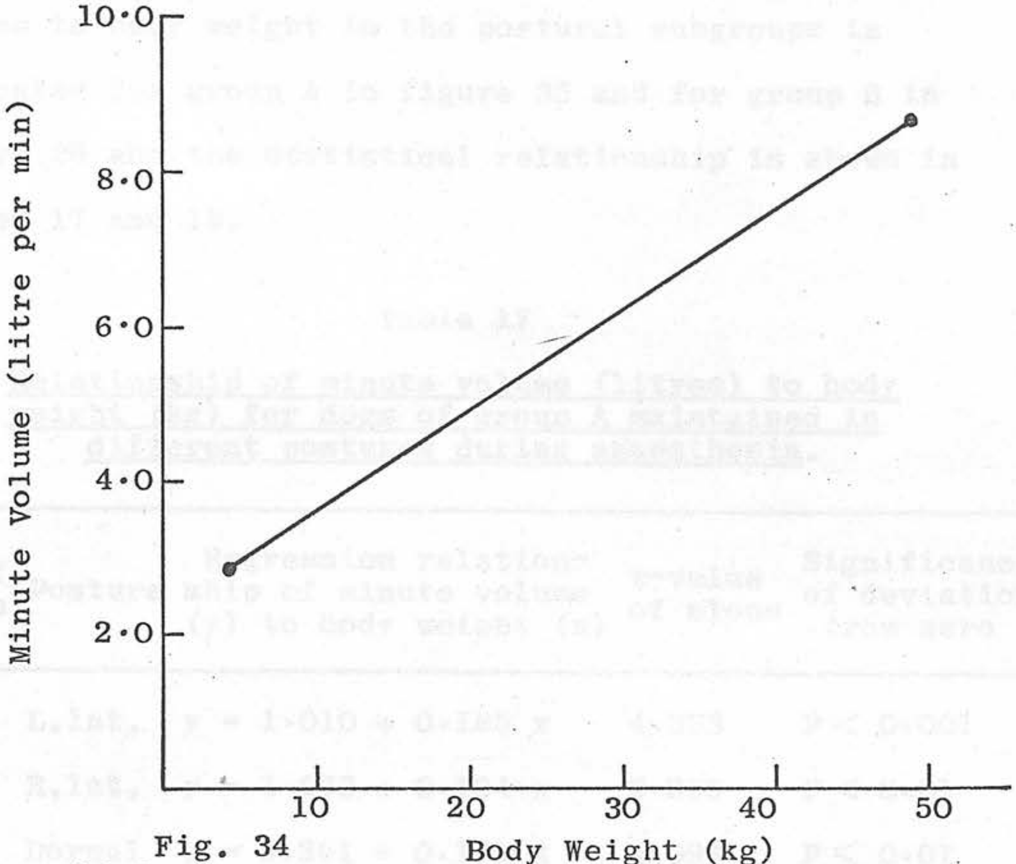
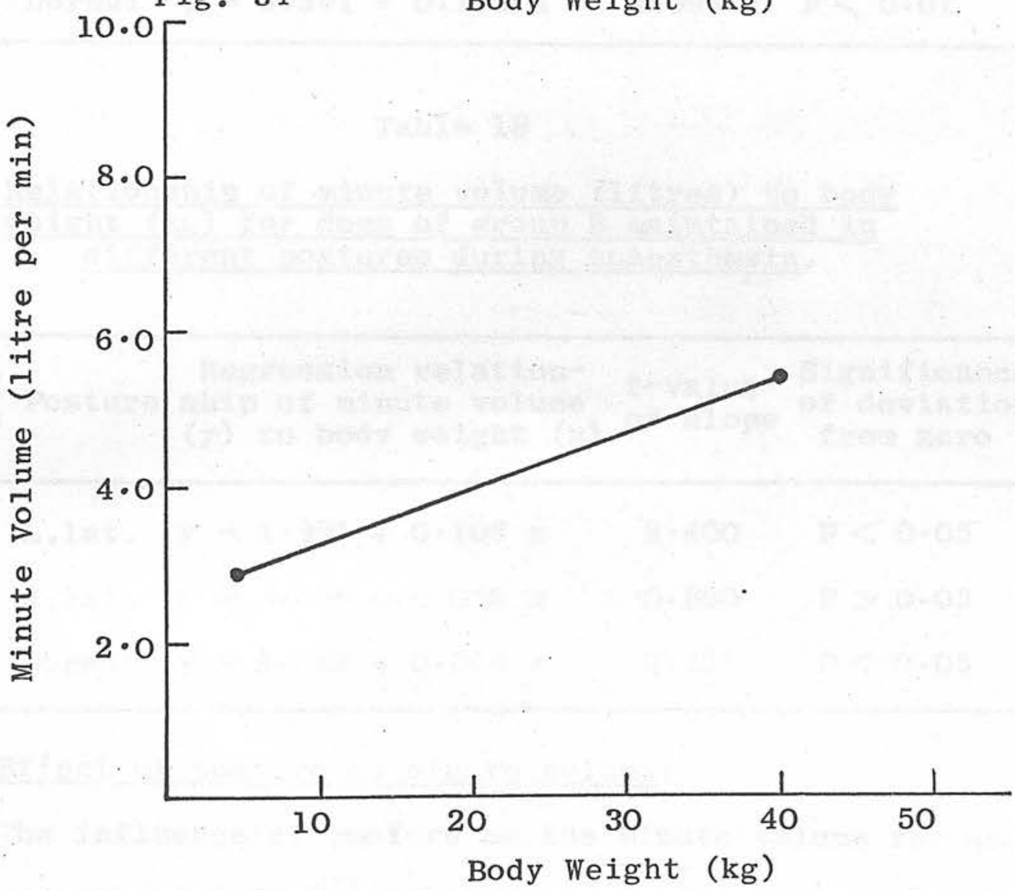

10·0
8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
Body Weight (kg)

Fig. 34


10·0
8·0
6·0
4·0
2·0
Minute Volume (litre per min)
10
20
30
40
50
Body Weight (kg)

More detailed study of the relationship of minute volume to body weight in the postural subgroups is indicated for group A in figure 35 and for group B in figure 36 and the statistical relationship is shown in tables 17 and 18.

Table 17

Relationship of minute volume (litres) to body weight (kg) for dogs of group A maintained in different postures during anaesthesia.

No. of dogs	Posture	Regression relationship of minute volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
14	L.lat.	$y = 1{\cdot}010 + 0{\cdot}195\ x$	4·333	$P < 0{\cdot}001$
16	R.lat.	$y = 1{\cdot}973 + 0{\cdot}104\ x$	3·250	$P < 0{\cdot}01$
20	Dorsal	$y = 2{\cdot}261 + 0{\cdot}131\ x$	4·094	$P < 0{\cdot}01$

Table 18

Relationship of minute volume (litres) to body weight (kg) for dogs of group B maintained in different postures during anaesthesia.

No. of dogs	Posture	Regression relationship of minute volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
13	L.lat.	$y = 1{\cdot}991 + 0{\cdot}108\ x$	2·400	$P < 0{\cdot}05$
16	R.lat.	$y = 3{\cdot}096 + 0{\cdot}036\ x$	0·800	$P > 0{\cdot}05$
21	Dorsal	$y = 2{\cdot}682 + 0{\cdot}068\ x$	2·125	$P < 0{\cdot}05$

5.3c Effect of posture on minute volume:

The influence of posture on the minute volume for any given weight of animal can be interpreted from figures 35

Fig. 35

Comparison of the relationship of minute volume to body weight of dogs in group A maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 36

Comparison of the relationship of minute volume to body weight of dogs in group B maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 35

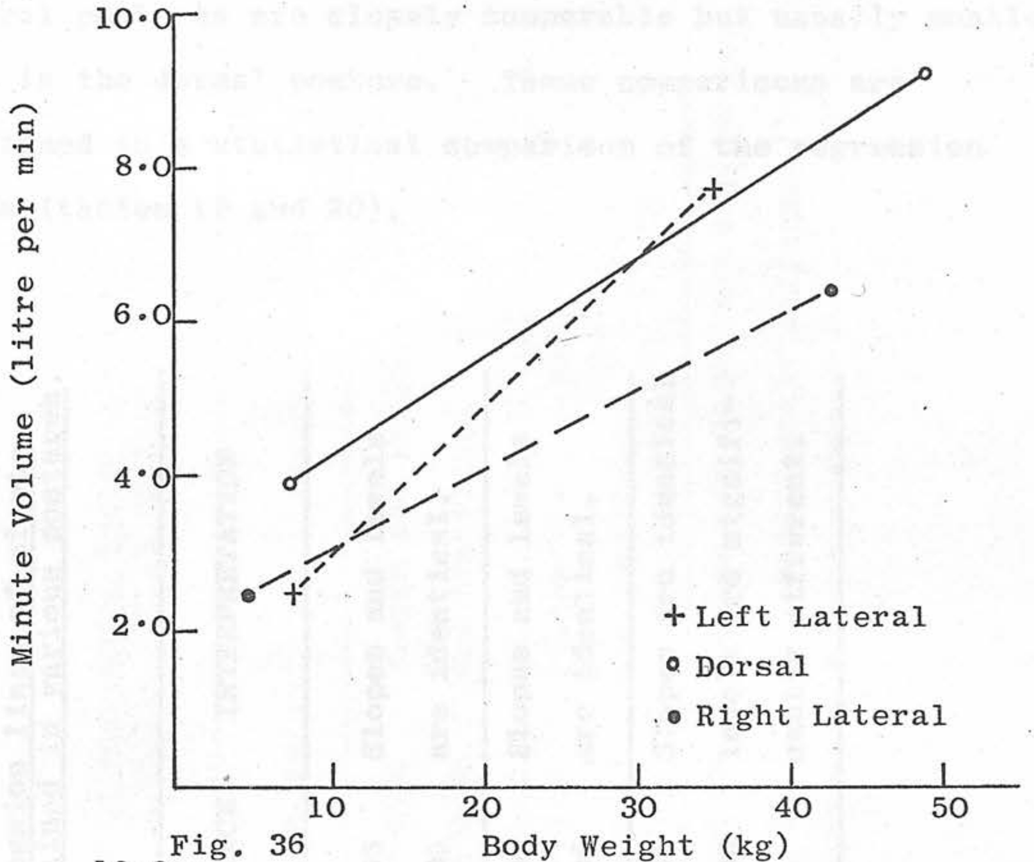
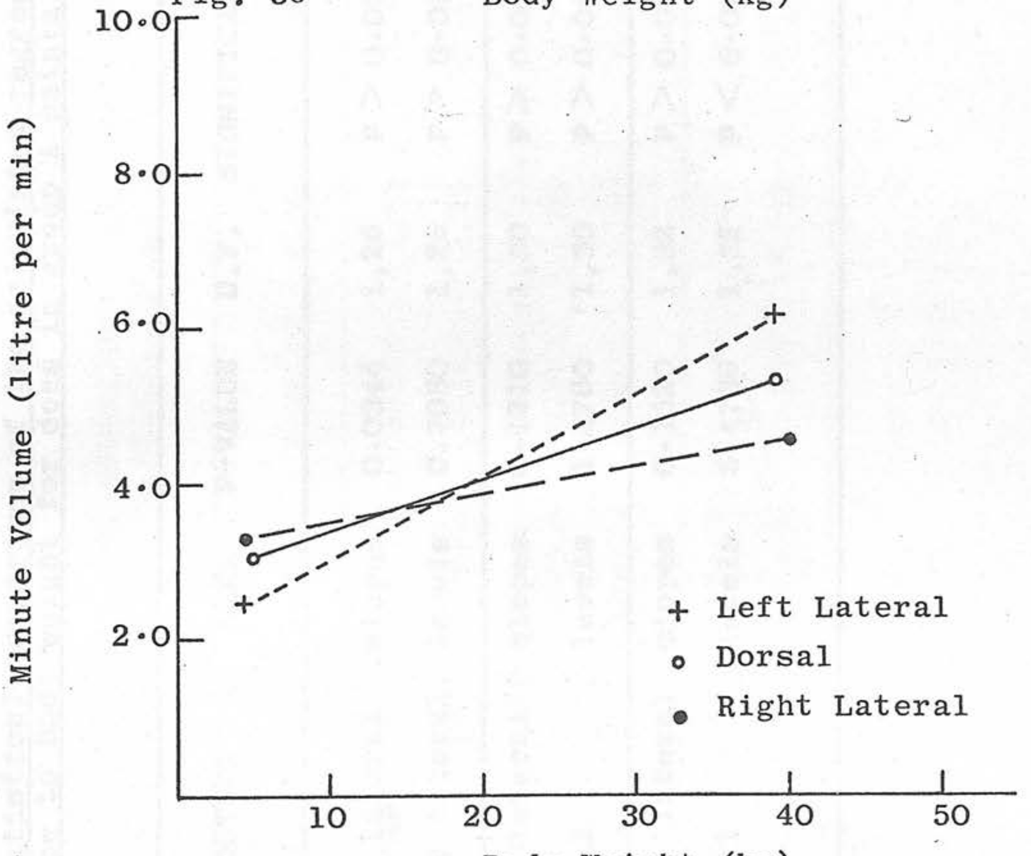

Minute Volume (litre per min)
10·0
8·0
6·0
4·0
2·0
10
20
30
40
50
Body Weight (kg)
+ Left Lateral
o Dorsal
● Right Lateral

Fig. 36


Minute Volume (litre per min)
10·0
8·0
6·0
4·0
2·0
10
20
30
40
50
Body Weight (kg)
+ Left Lateral
o Dorsal
● Right Lateral

and 36 . In both groups A and B the minute volume in the lateral postures are closely comparable but usually smaller than in the dorsal posture. These comparisons are confirmed in a statistical comparison of the regression lines (tables 19 and 20).

Table 19

Statistical comparison of the calculated regression lines of minute volume to body weight for dogs in group A maintained in various postures.

POSTURE	LINE	F-VALUE	D.F.	SIGNIFICANCE	INTERPRETATION
Left lateral	slopes	0.0344	1,26	$P > 0.05$	Slopes and levels
Right lateral	levels	0.7080	1,26	$P > 0.05$	are identical.
Left lateral	slopes	0.1210	1,30	$P > 0.05$	Slopes and levels
Dorsal	levels	1.5760	1,30	$P > 0.05$	are identical.
Right lateral	slopes	0.1520	1,32	$P > 0.05$	Slopes are identical
Dorsal	levels	5.4736	1,32	$P < 0.05$	levels are significantly different.

Table 20

Statistical comparison of the calculated regression lines of minute volume to body weight for dogs in group B maintained in various postures.

POSTURE	LINE	F-VALUE	D.F.	SIGNIFICANCE	INTERPRETATION
Left lateral	slopes	1·464	1,25	$P > 0{\cdot}05$	Slopes and levels
Right lateral	levels	0·158	1,25	$P > 0.05$	are identical.
Left lateral	slopes	0·765	1,30	$P > 0.05$	Slopes and levels
Dorsal	levels	0·007	1,30	$P > 0.05$	are identical.
Right lateral	slopes	0·601	1,33	$P > 0.05$	Neither the slopes nor the levels
Dorsal	levels	0·286	1,33	$P > 0.05$	are significantly different.

5.4 PULSE RATE

5.4a Pulse rate during anaesthesia:

Pulse rate was found to fall progressively and comparably throughout the 60 minutes of anaesthesia both in group A (figure 37) and in group B (figure 38).

The regression relationship between the duration of anaesthesia and pulse rate for the total number of dogs in each group, calculated by the method used for the respiratory parameters of deriving the mean intercept and slope of each animal's regression line, is illustrated in figure 39 and in figure 40. The regression slopes for both groups were very highly significantly deviated from zero (table 21).

Table 21

Relationship of pulse rate (beats per min) to duration of anaesthesia (mins) for the total number of dogs in groups A and B.

No.of dogs	Group	Regression relationship of pulse rate (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
50	A	$y = 150{\cdot}304 - 0{\cdot}618x$	$-7{\cdot}50$	$P < 0{\cdot}001$
50	B	$y = 152{\cdot}193 - 0{\cdot}693x$	$-15{\cdot}92$	$P < 0{\cdot}001$

5.4b Relationship of pulse rate to body weight:

The relationship between pulse rate and body weight for groups A and B is presented in figures 47 and 48 and the calculated regression lines of the body weight with pulse rate in different body positions as well as the t-value of their slopes are given in tables 22 and 23.

No significant corelation was found between body weight and pulse rate in either of groups A or B.

Fig. 37

Mean ($\pm$ standard error) values of pulse rate of 50 clinical dogs in group A during 60 minutes of anaesthesia.

Fig. 38

Mean ($\pm$ standard error) values of pulse rate of 50 clinical dogs in group B during 60 minutes of anaesthesia.

Fig. 37

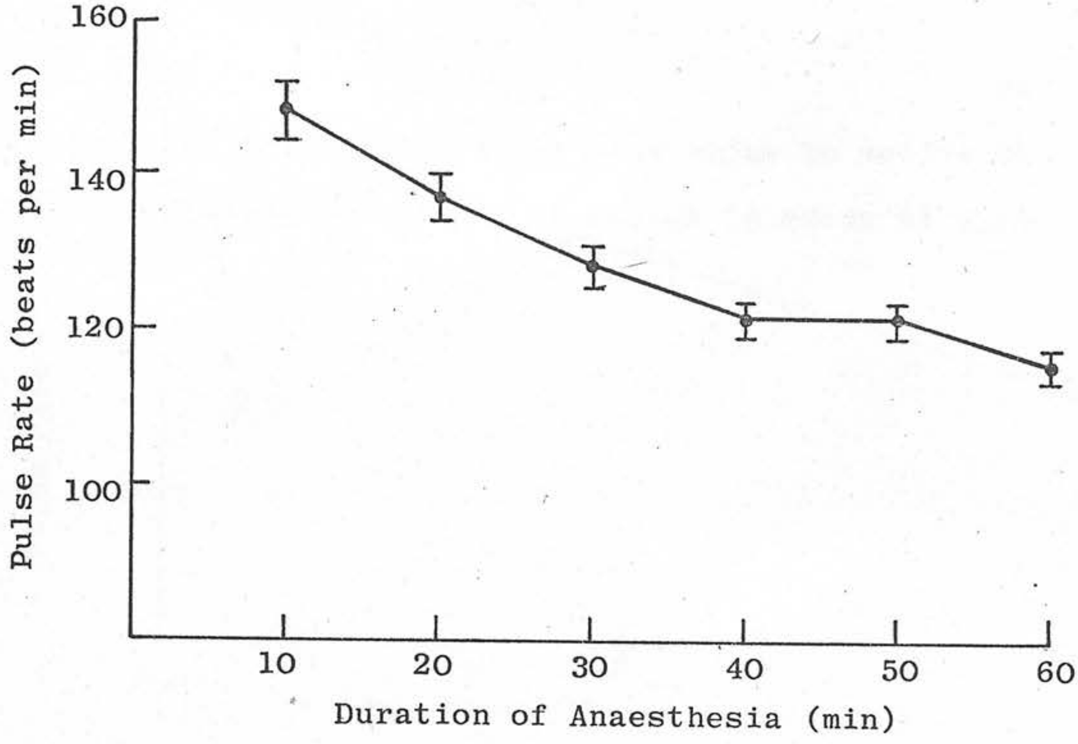

160
140
120
100
Pulse Rate (beats per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 38

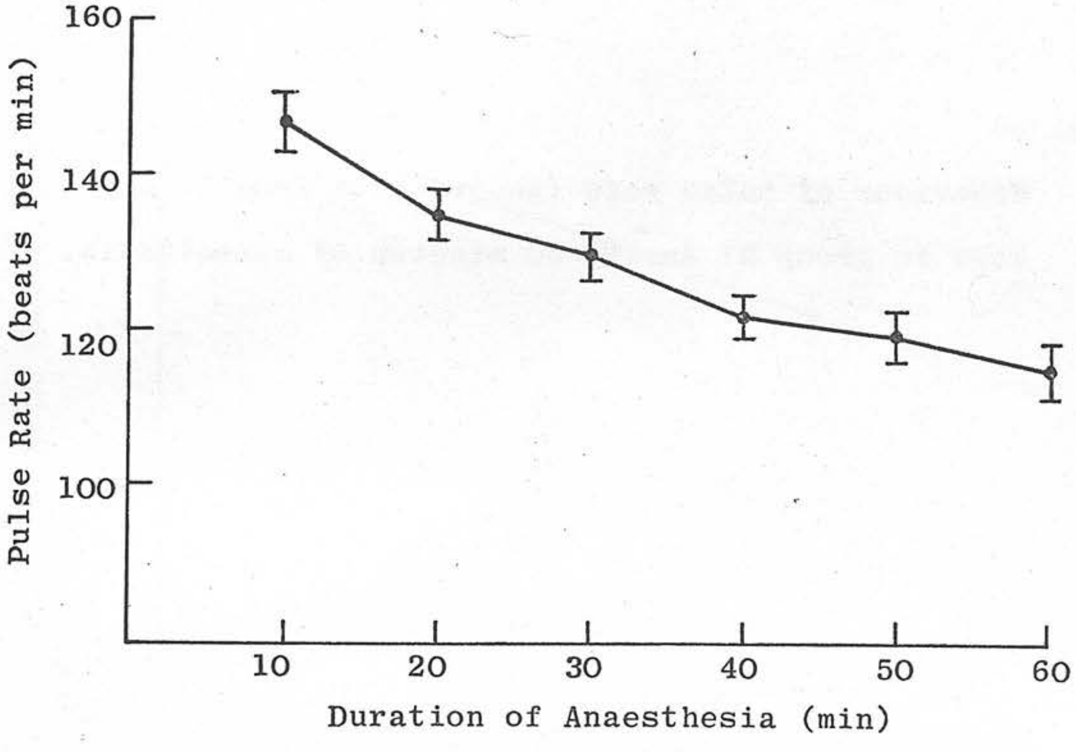

160
140
120
100
Pulse Rate (beats per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 39

Behaviour of pulse rate (pooled data from 50 clinical dogs in group A) during 60 minutes of anaesthesia.

Fig. 40

Behaviour of pulse rate (pooled data from 50 clinical dogs in group B) during 60 minutes of anaesthesia.

Fig. 39

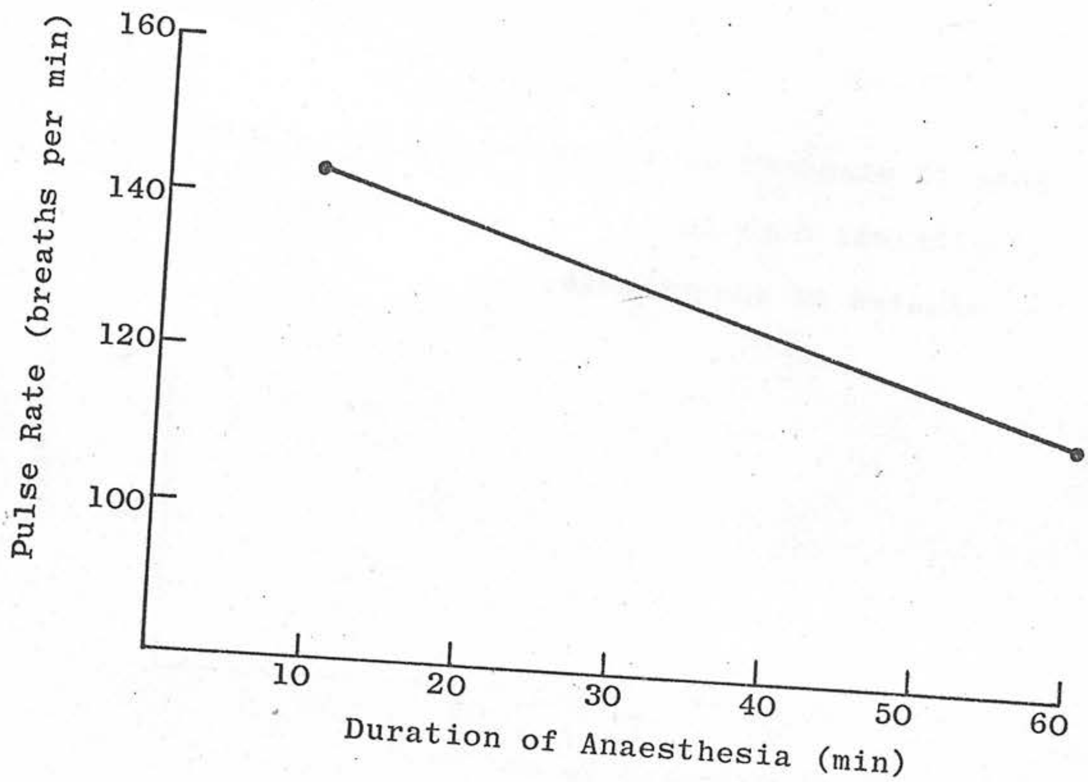

160
140
120
100
Pulse Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 40

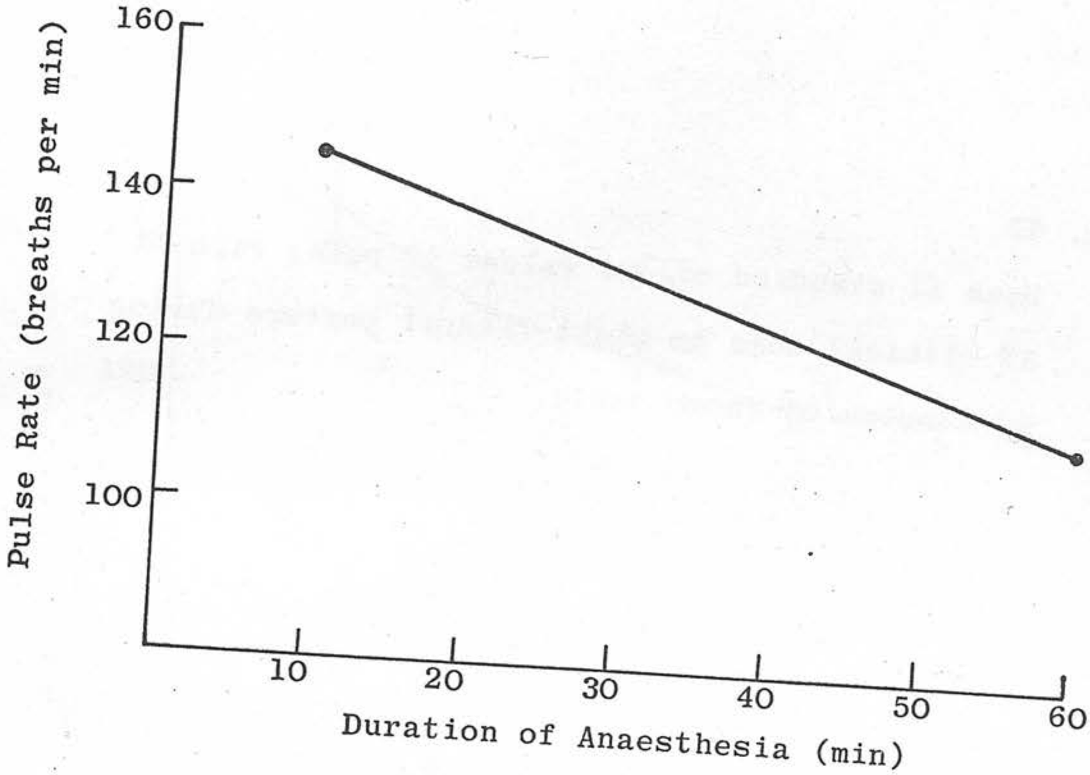

160
140
120
100
Pulse Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 41

Mean (± standard error) values of pulse rate of 27 clinical dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 42

Mean (± standard error) values of pulse rate of 32 clinical dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 41

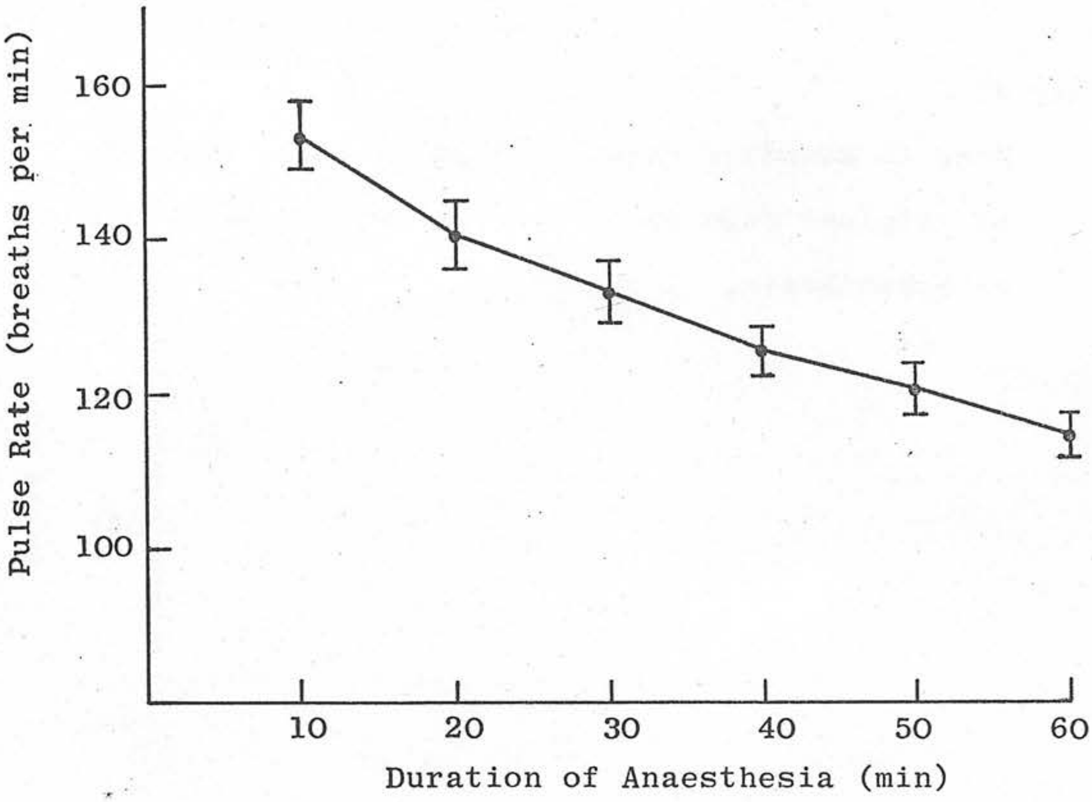

160
140
120
100
Pulse Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 42

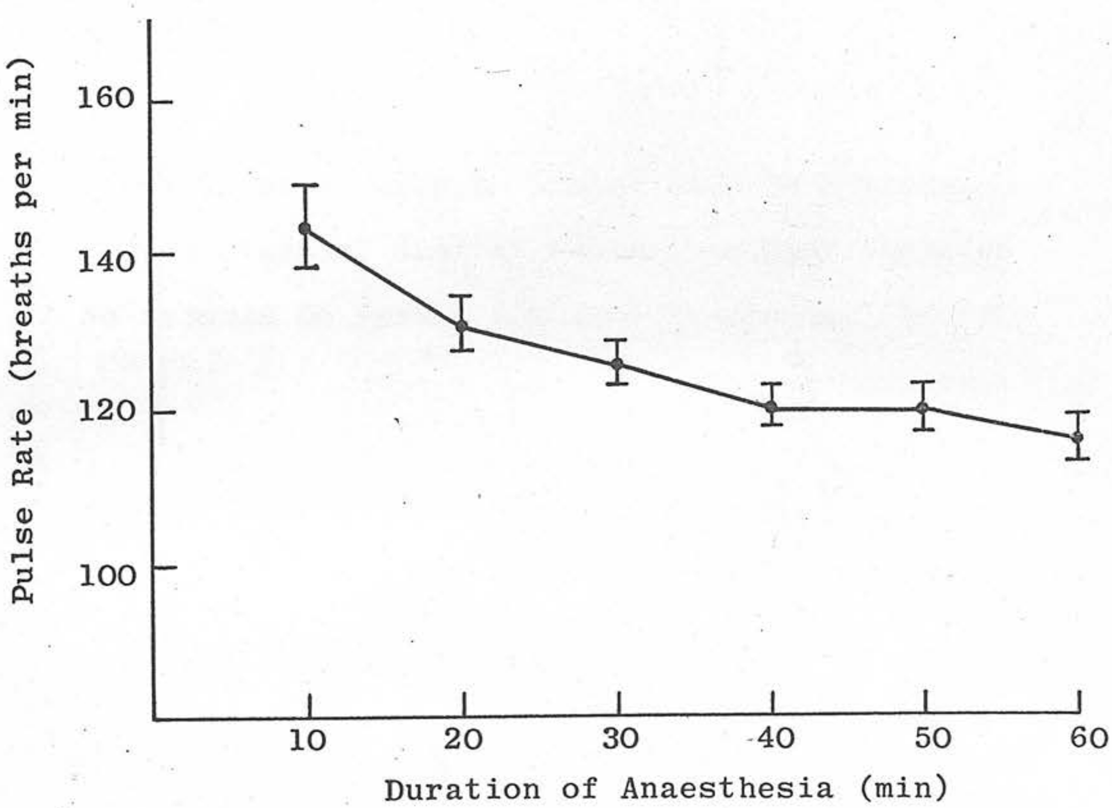

160
140
120
100
Pulse Rate (breaths per min)
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 43

Mean (± standard error) values of pulse rate of 41 clinical dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 44

Comparison of mean values of pulse rate of 100 clinical dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 43

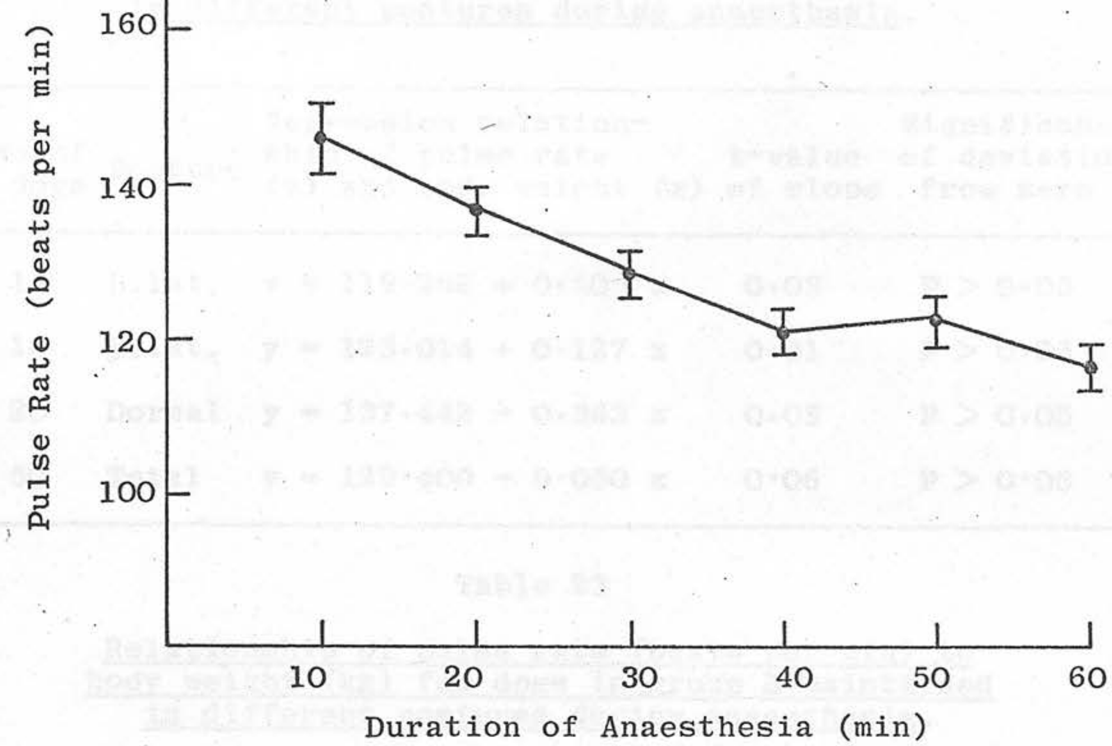

Pulse Rate (beats per min)
160
140
120
100
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 44

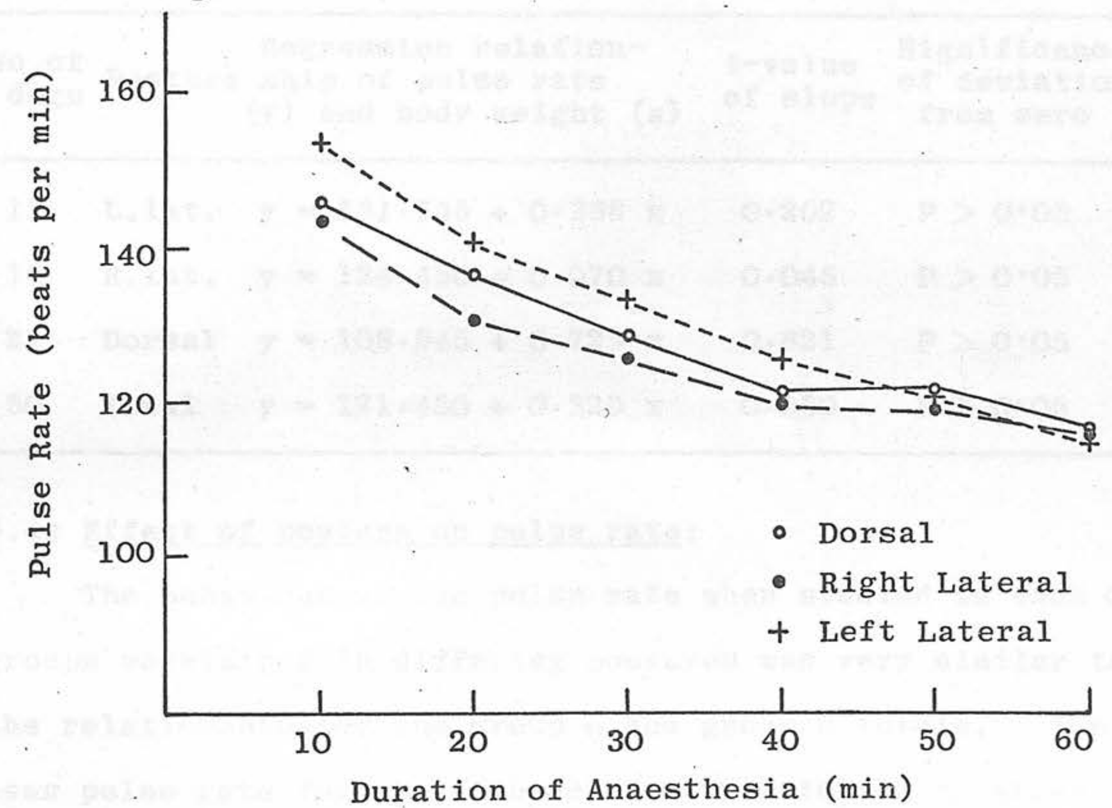

Pulse Rate (beats per min)
160
140
120
100
○ Dorsal
● Right Lateral
+ Left Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

Table 22

Relationship of pulse rate (beats per min) to body weight (kg) for dogs in group A maintained in different postures during anaesthesia.

No. of dogs	Posture	Regression relationship of pulse rate (y) and body weight (x)	t-value of slope	Significance of deviation from zero
14	L.lat.	$y = 119{\cdot}262 + 0{\cdot}505\ x$	0·03	$P > 0{\cdot}05$
16	R.lat.	$y = 123{\cdot}014 + 0{\cdot}127\ x$	0·01	$P > 0{\cdot}05$
20	Dorsal	$y = 137{\cdot}442 - 0{\cdot}363\ x$	0·03	$P > 0{\cdot}05$
50	Total	$y = 129{\cdot}400 - 0{\cdot}050\ x$	0·06	$P > 0{\cdot}05$

Table 23

Relationship of pulse rate (beats per min) to body weight (kg) for dogs in group B maintained in different postures during anaesthesia.

No. of dogs	Posture	Regression relationship of pulse rate (y) and body weight (x)	t-value of slope	Significance of deviation from zero
13	L.lat.	$y = 131{\cdot}755 + 0{\cdot}398\ x$	0·202	$P > 0{\cdot}05$
16	R.lat.	$y = 124{\cdot}480 + 0{\cdot}070\ x$	0·045	$P > 0{\cdot}05$
21	Dorsal	$y = 108{\cdot}945 + 0{\cdot}729\ x$	0·621	$P > 0{\cdot}05$
50	Total	$y = 121{\cdot}450 + 0{\cdot}320\ x$	0·030	$P > 0{\cdot}05$

5.4c Effect of posture on pulse rate:

The behaviour of the pulse rate when studied in each of the groups maintained in differing postures was very similar to the relationship for the group A and group B totals. The mean pulse rate for the combined postural totals is shown in figures 41 - 44 and the regression relationship of the postural relationships for groups A and B is shown in

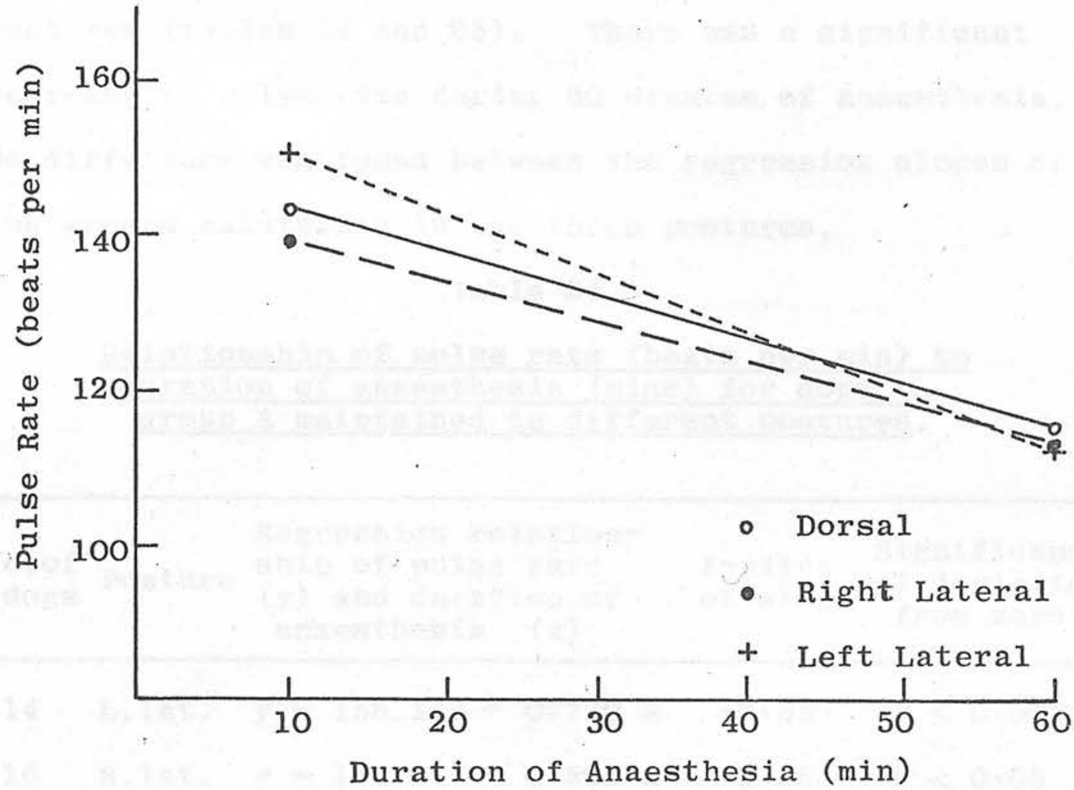
Fig. 45

Comparison of the behaviour of pulse rate of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 46

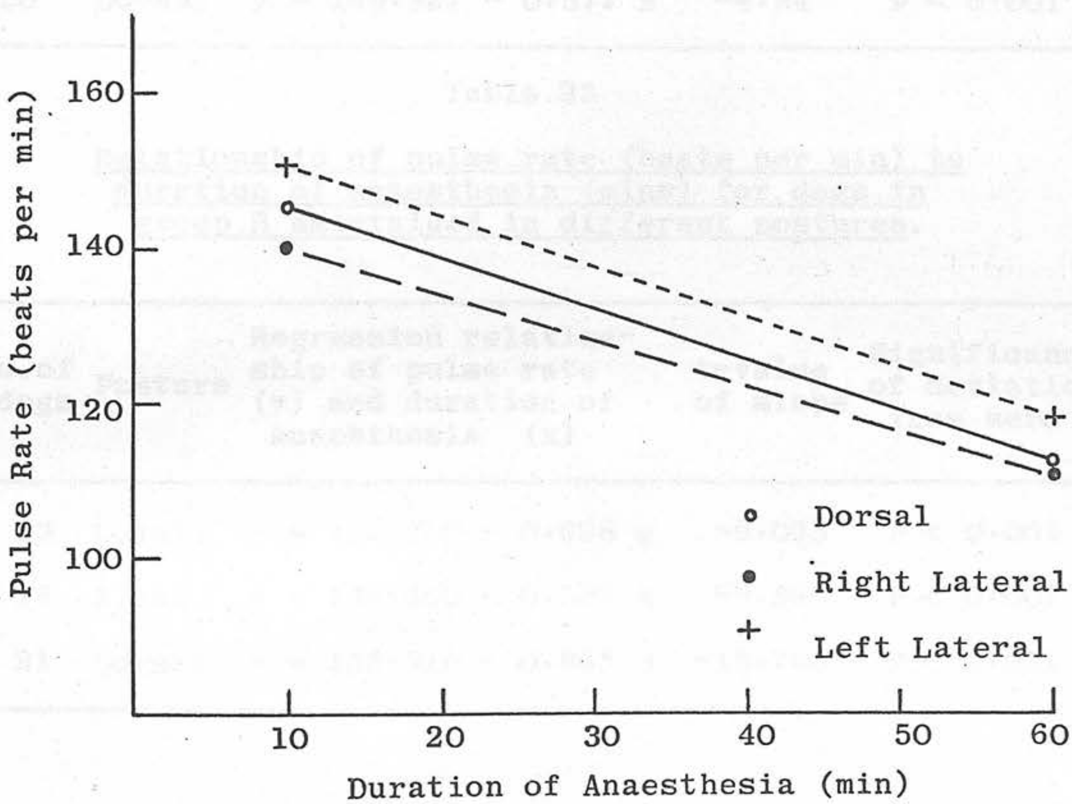
Comparison of the behaviour of pulse rate of group B dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 45



Pulse Rate (beats per min)
160
140
120
100
Dorsal
Right Lateral
Left Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 46



Pulse Rate (beats per min)
160
140
120
100
Dorsal
Right Lateral
Left Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

figures (45) and (46). The relationship of duration of anaesthesia to pulse rate was significant for each of the postures (tables 24 and 25). There was a significant decrease in pulse rate during 60 minutes of anaesthesia. No difference was found between the regression slopes of the groups maintained in the three postures.

Table 24

Relationship of pulse rate (beats per min) to duration of anaesthesia (mins) for dogs in group A maintained in different postures.

No.of dogs	Posture	Regression relationship of pulse rate (y) and duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
14	L.lat.	$y = 158.142 - 0{\cdot}770\ x$	$-6{\cdot}83$	$P < 0{\cdot}001$
16	R.lat.	$y = 144{\cdot}667 - 0{\cdot}536\ x$	$-2{\cdot}85$	$P < 0{\cdot}05$
20	Dorsal	$y = 149{\cdot}327 - 0{\cdot}577\ x$	$-4{\cdot}84$	$P < 0{\cdot}001$

Table 25

Relationship of pulse rate (beats per min) to duration of anaesthesia (mins) for dogs in group B maintained in different postures.

No.of dogs	Posture	Regression relationship of pulse rate (y) and duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
13	L.lat.	$y = 156{\cdot}550 - 0{\cdot}628\ x$	$-9{\cdot}025$	$P < 0{\cdot}001$
16	R.lat.	$y = 146{\cdot}400 - 0{\cdot}587\ x$	$-9{\cdot}360$	$P < 0{\cdot}001$
21	Dorsal	$y = 153{\cdot}910 - 0{\cdot}863\ x$	$-15{\cdot}760$	$P < 0{\cdot}001$

Fig. 47

Relationship of pulse rate to body weight (pooled data from 50 clinical dogs in group A) during 60 minutes of anaesthesia.

Fig. 48

Relationship of pulse rate to body weight (pooled data from 50 clinical dogs in group B) during 60 minutes of anaesthesia.

Fig. 47

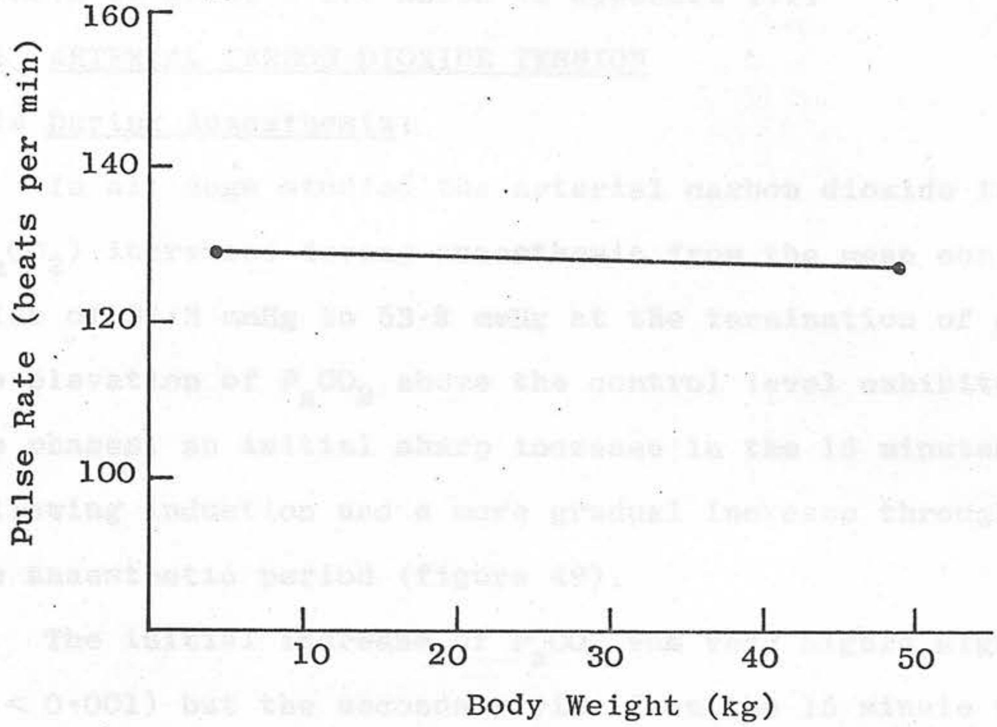
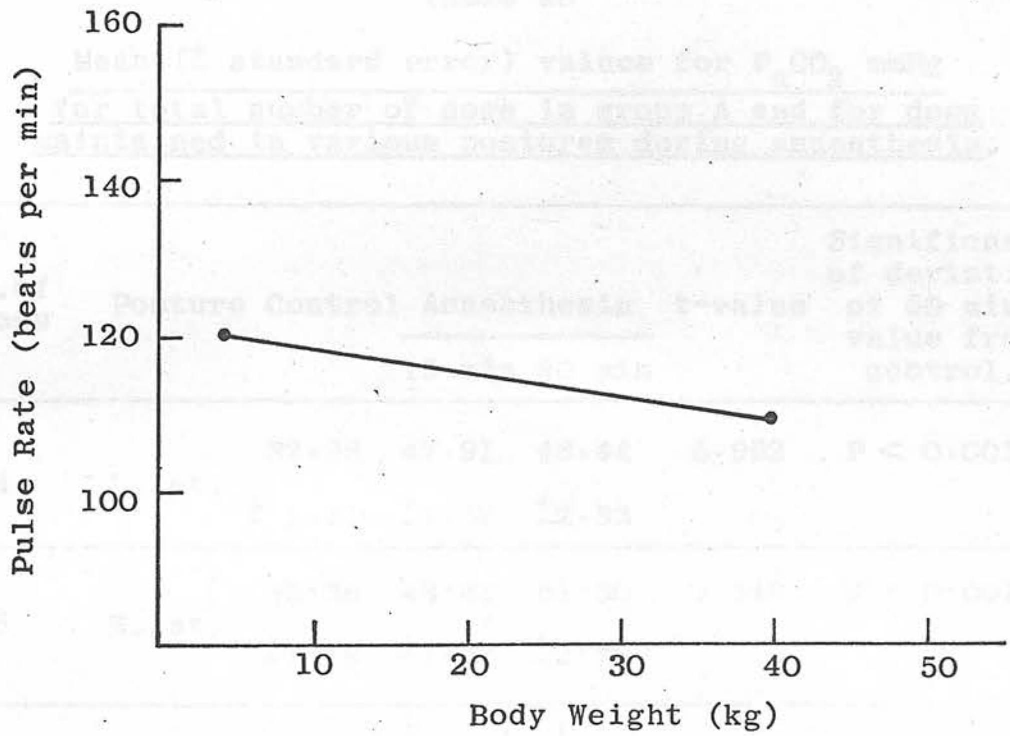

160
140
120
100
Pulse Rate (beats per min)
10
20
30
40
50
Body Weight (kg)

Fig. 48


160
140
120
100
Pulse Rate (beats per min)
10
20
30
40
50
Body Weight (kg)

6.0 BIOCHEMICAL PARAMETERS

The biochemical data obtained during the study from animals in group A are shown in appendix III.

6.1 ARTERIAL CARBON DIOXIDE TENSION

6.1a During Anaesthesia:

In all dogs studied the arterial carbon dioxide tension (P_aCO_2) increased during anaesthesia from the mean control value of 34·3 mmHg to 53·2 mmHg at the termination of surgery. The elevation of P_aCO_2 above the control level exhibited two phases, an initial sharp increase in the 15 minutes following induction and a more gradual increase throughout the anaesthetic period (figure 49).

The initial increase of P_aCO_2 was very highly significant ($P < 0{\cdot}001$) but the secondary rise from the 15 minute to the 60 minute samples was not significant (table 26).

Table 26

Mean ($\pm$ standard error) values for P_aCO_2 mmHg for total number of dogs in group A and for dogs maintained in various postures during anaesthesia.

No. of dogs	Posture	Control	Anaesthesia 15 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control.
14	L.lat.	32·98 $\pm$ 1·11	47·91 $\pm$1·52	48·44 $\pm$2·33	5·992	$P < 0{\cdot}001$
16	R.lat.	35·36 $\pm$1·19	48·82 $\pm$1·37	51·30 $\pm$2·72	5·349	$P < 0{\cdot}001$
20	Dorsal	34·37 $\pm$0·90	53·88 $\pm$2·18	58·06 $\pm$2·75	8·169	$P < 0{\cdot}001$
50	Total	34·30 $\pm$0·61	50·59 $\pm$1.11	53·20 $\pm$1·63	10·831	$P < 0{\cdot}001$

Fig. 49

Mean (± standard error) values of carbon dioxide tension of 50 clinical dogs in group A during 60 minutes of anaesthesia.

Fig. 54

Mean (± standard error) values of pH of 50 clinical dogs in group A during 60 minutes of anaesthesia.

Fig. 59

Mean (± standard error) values of standard bicarbonate of 50 clinical dogs in group A during 60 minutes of anaesthesia.

Fig. 49

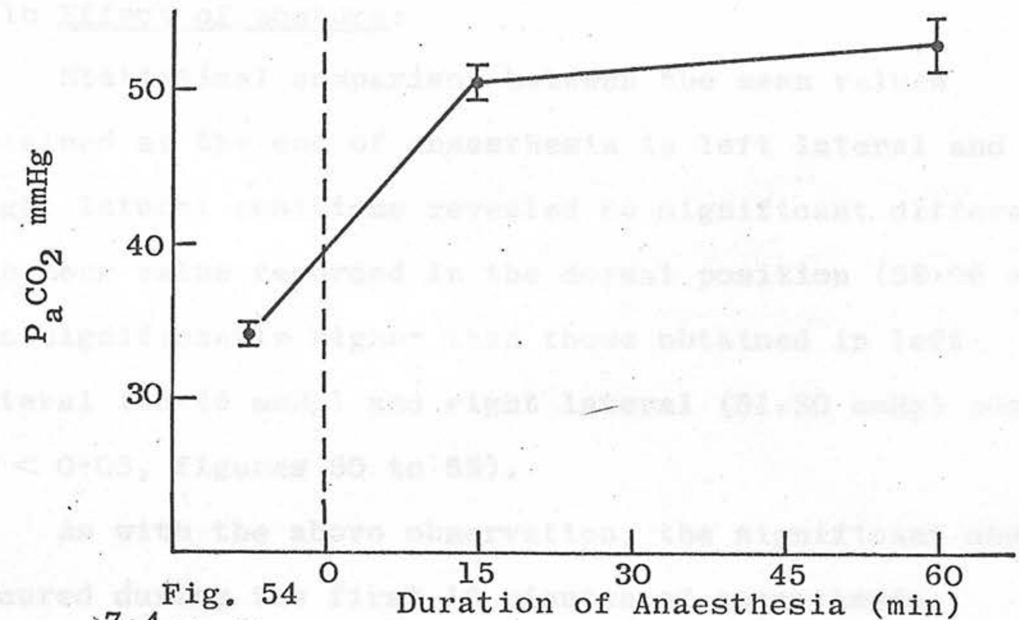


Fig. 54

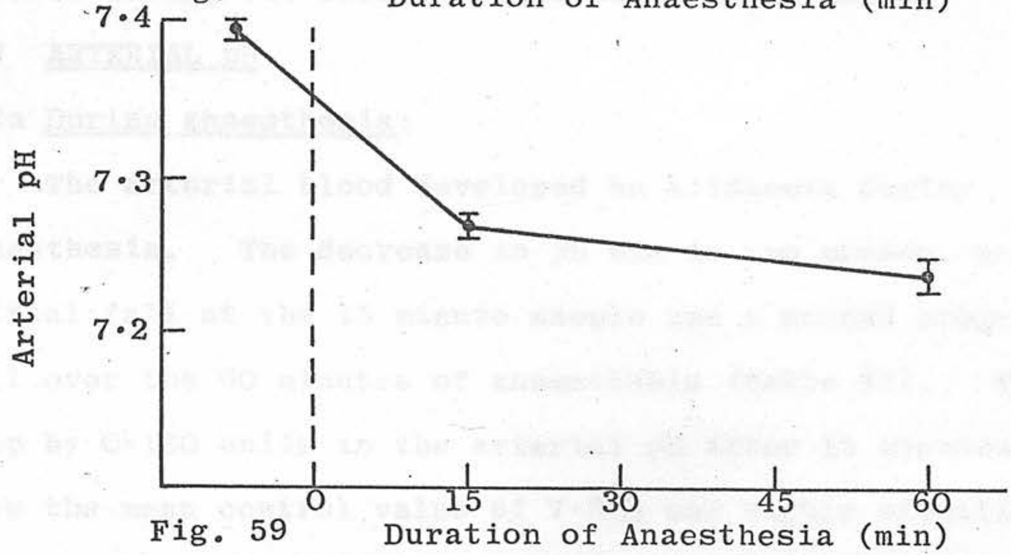
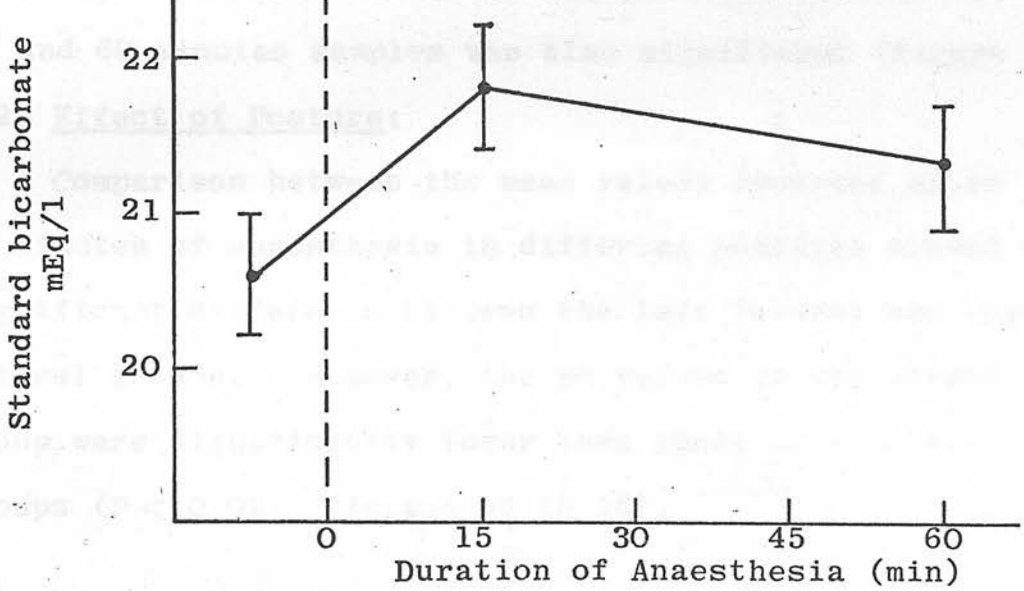


Fig. 59



6.1b Effect of posture:

Statistical comparison between the mean values obtained at the end of anaesthesia in left lateral and right lateral positions revealed no significant difference. The mean value recorded in the dorsal position (58·06 mmHg) was significantly higher than those obtained in left lateral (48·44 mmHg) and right lateral (51.30 mmHg) positions ($P < 0{\cdot}05$, figures 50 to 53).

As with the above observation, the significant changes occured during the first 15 minutes of anaesthesia.

6.2 ARTERIAL pH

6.2a During anaesthesia:

The arterial blood developed an acidaemia during anaesthesia. The decrease in pH was in two phases, an initial fall at the 15 minute sample and a second progressive fall over the 60 minutes of anaesthesia (table 27). The drop by 0·130 units in the arterial pH after 15 minutes from the mean control value of 7·395 was highly significant ($P < 0{\cdot}01$) and the fall by 0·033 pH units between the 15 and 60 minutes samples was also significant (figure 54).

6.2b Effect of Posture:

Comparison between the mean values recorded after 60 minutes of anaesthesia in differing postures showed no significant difference between the left lateral and right lateral groups. However, the pH values of the dorsal group were significantly lower than those of the lateral groups ($P < 0{\cdot}01$) (figures 55 to 58).

Fig. 50

Mean ($\pm$ standard error) values of carbon dioxide tension of 14 clinical dogs in group A, in left lateral posture during 60 minutes of anaesthesia.

Fig. 51

Mean ($\pm$ standard error) values of carbon dioxide tension of 16 clinical dogs in group A, in right lateral posture during 60 minutes of anaesthesia.

Fig. 50

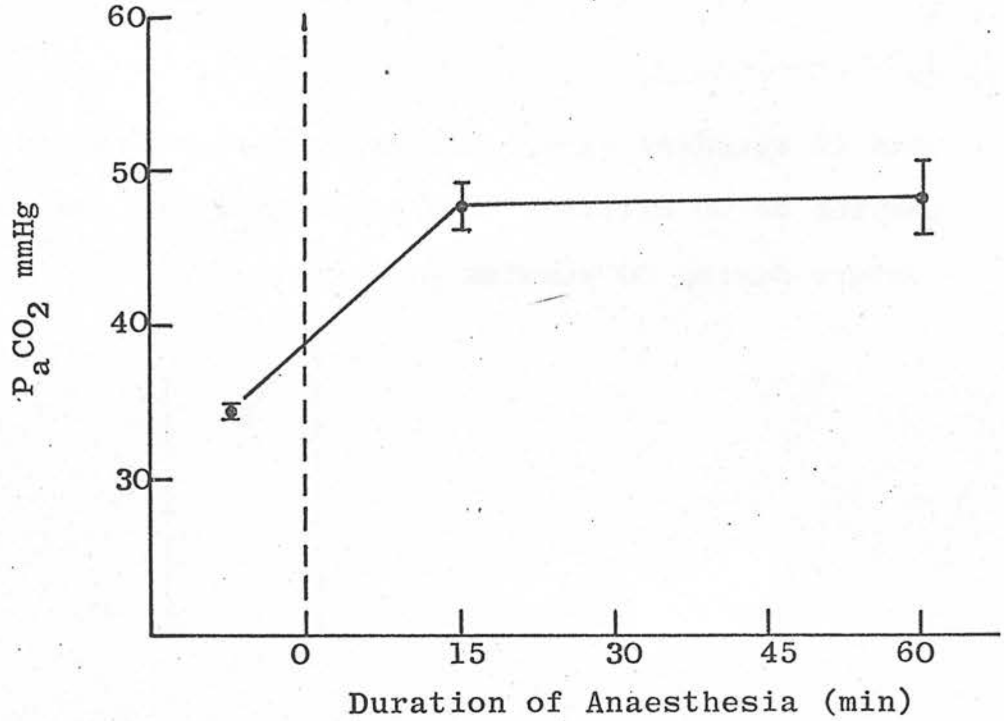

60
50
40
30
P_aCO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 51

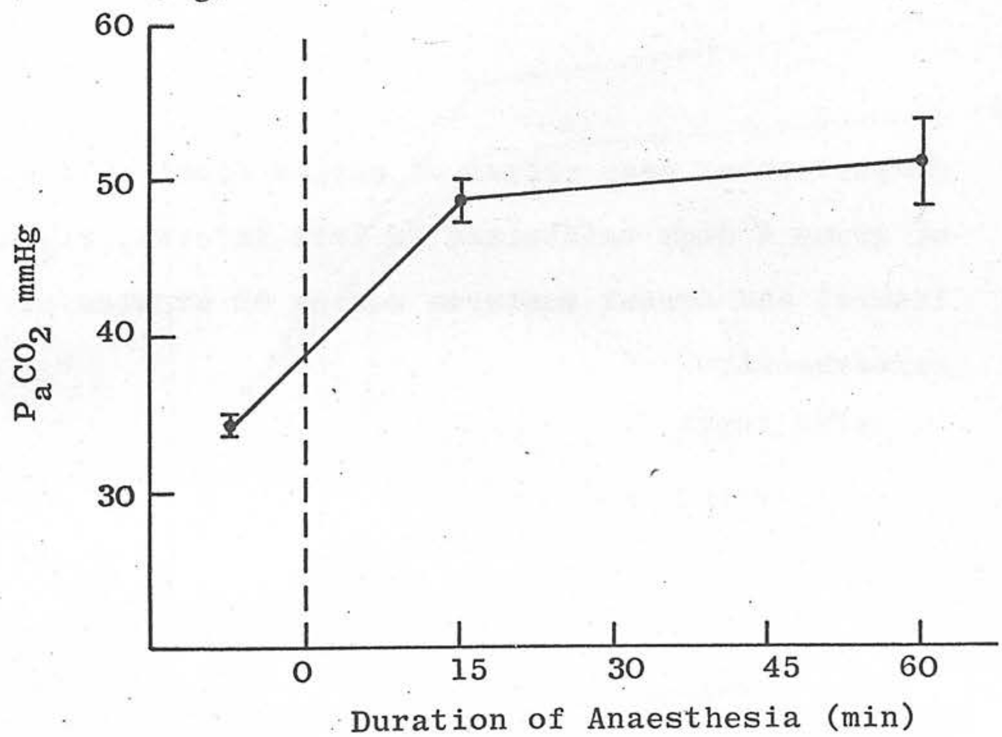

60
50
40
30
P_aCO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 52

Mean ($\pm$ standard error) values of carbon dioxide tension of 20 clinical dogs in group A, in dorsal posture during 60 minutes of anaesthesia.

Fig. 53

Comparison of mean values of carbon dioxide tension of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 52

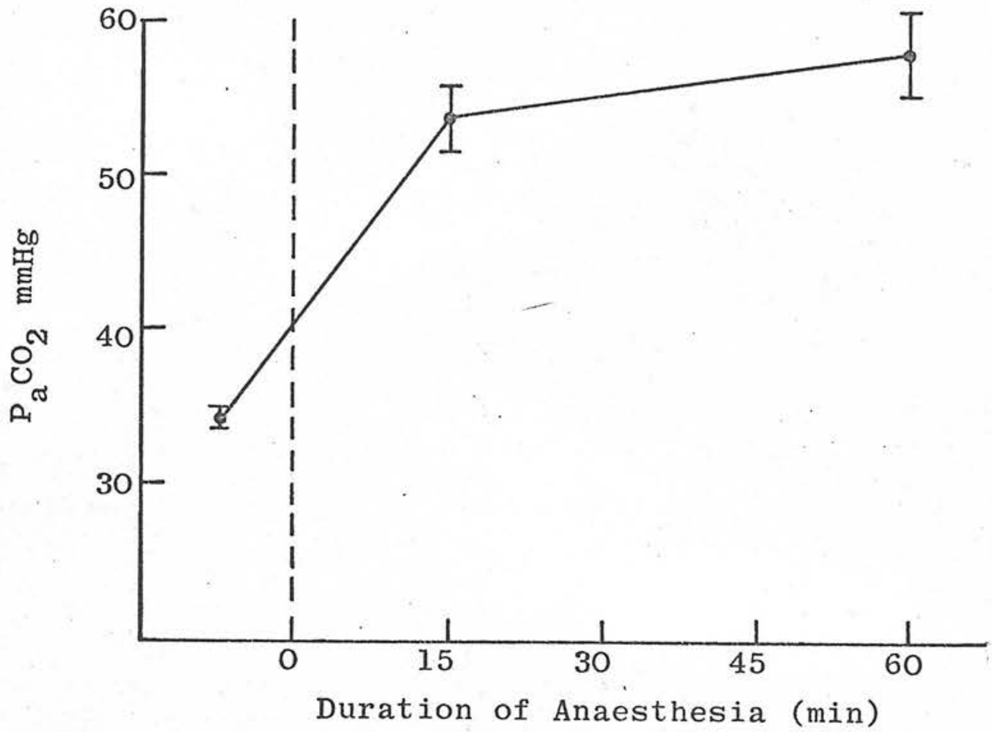

60
50
40
30
P_aCO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 53

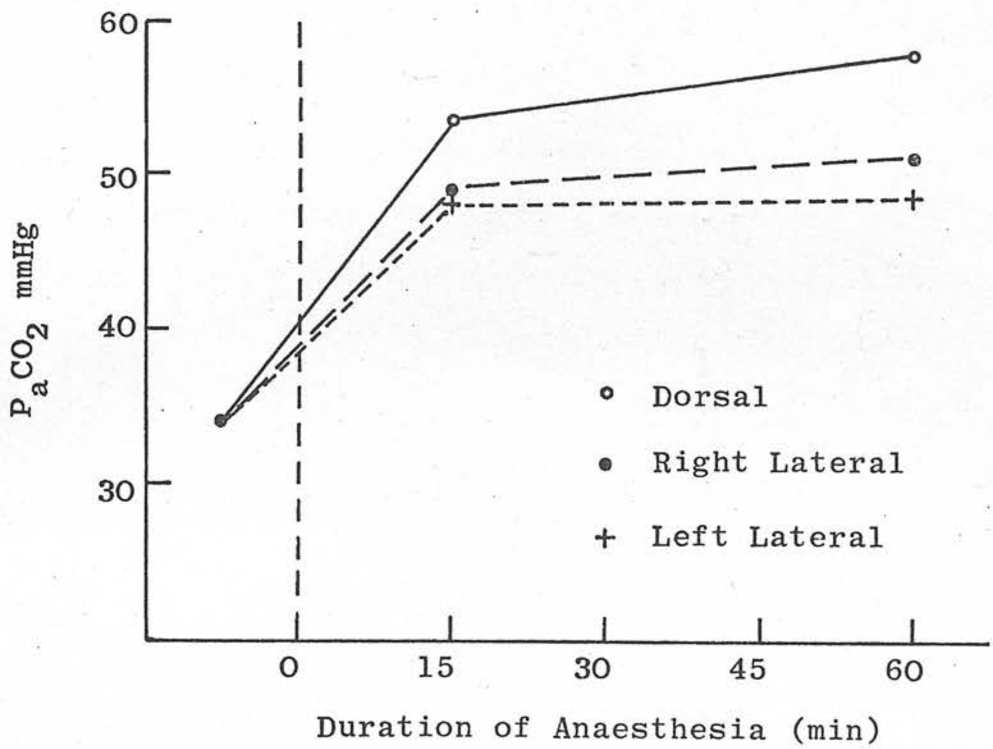

60
50
40
30
P_aCO_2 mmHg
Dorsal
Right Lateral
Left Lateral
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 54

Placed in sequence, for comparison, below Fig. 49.

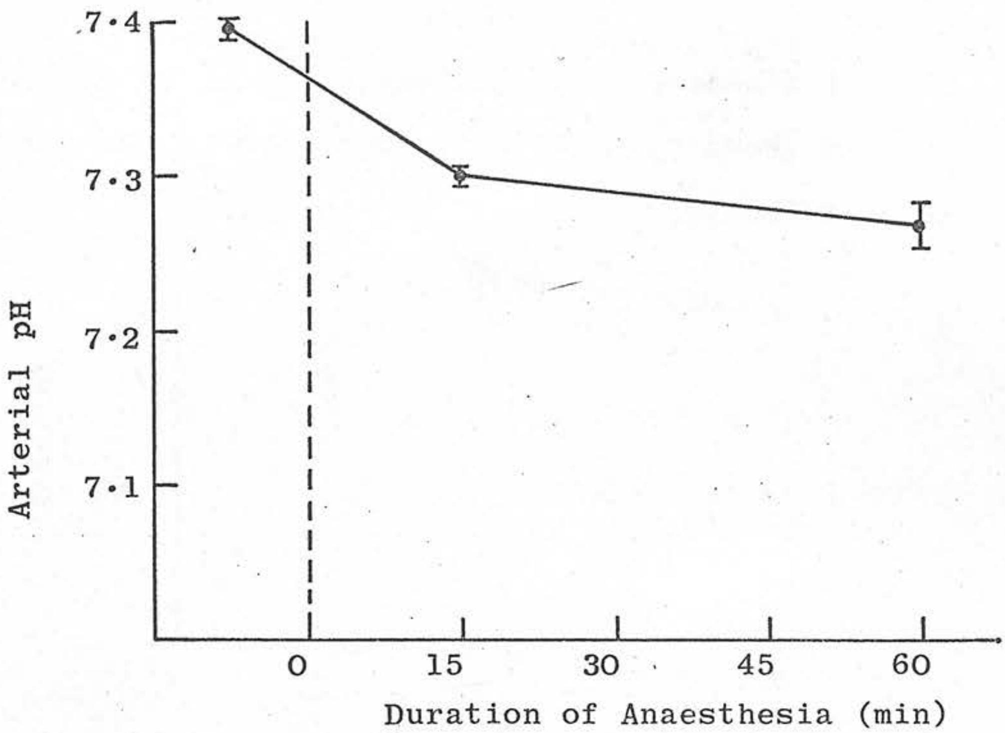
Fig. 55

Mean (± standard error) values of pH of 14 clinical dogs in group A, in left lateral posture during 60 minutes of anaesthesia.

Fig. 56

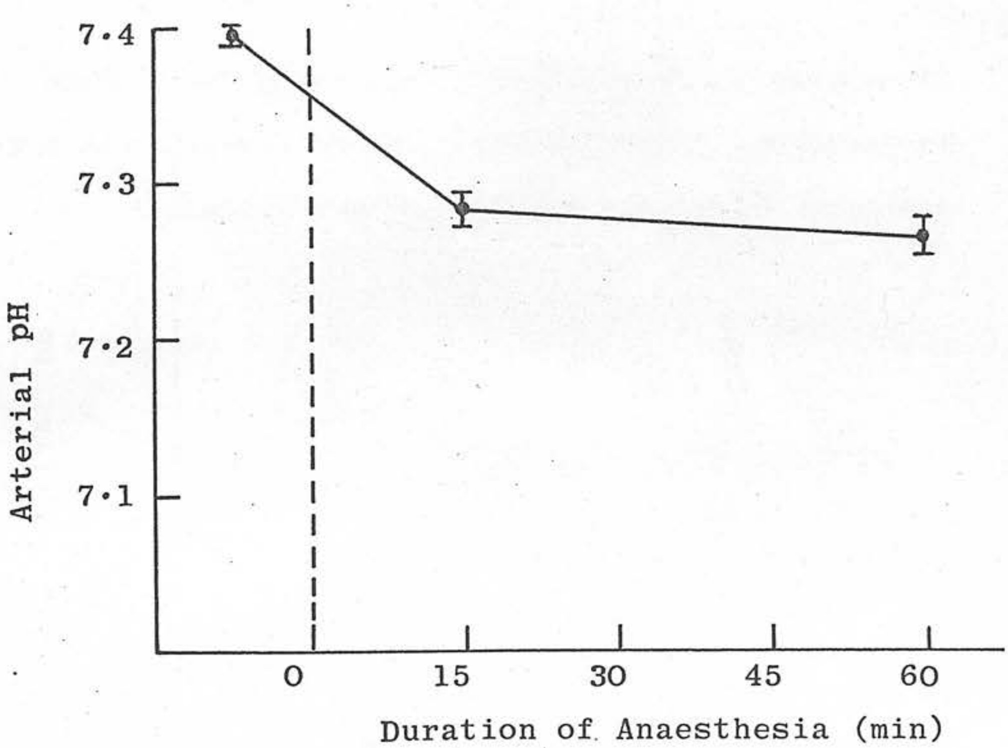
Mean (± standard error) values of pH of 16 clinical dogs in group A, in right lateral posture during 60 minutes of anaesthesia.

Fig. 55



7·4
7·3
7·2
7·1
Arterial pH
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 56



7·4
7·3
7·2
7·1
Arterial pH
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 57

Mean ($\pm$ standard error) values of pH of 20 clinical dogs in group A, in dorsal posture during 60 minutes of anaesthesia.

Fig. 58

Comparison of mean values of pH of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 57

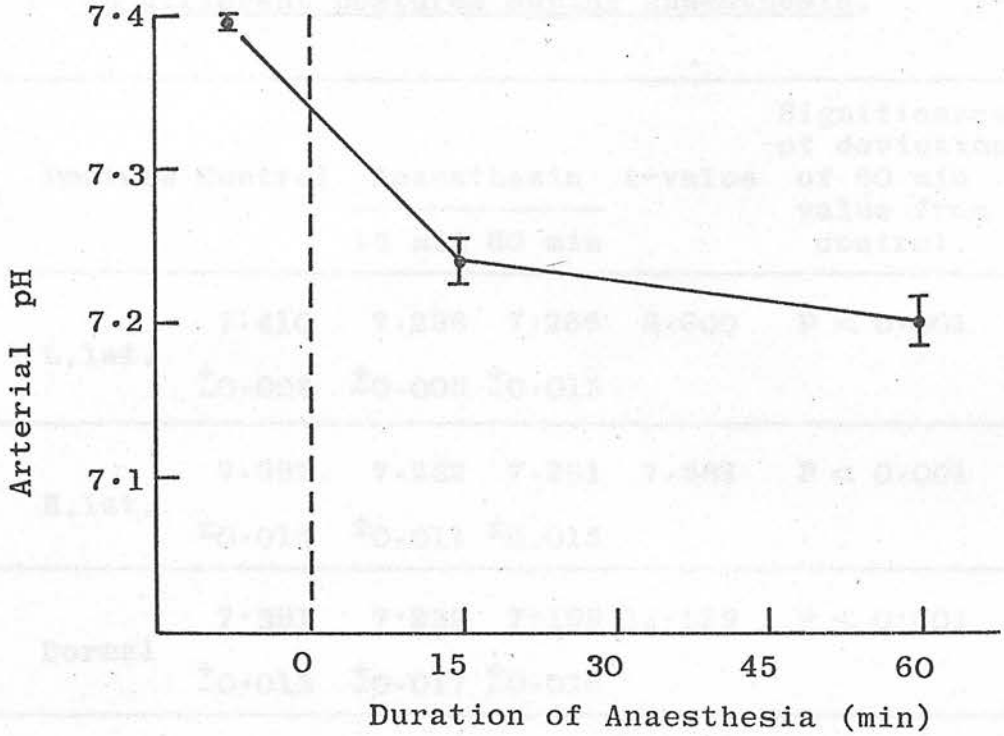

7·4
7·3
7·2
7·1
Arterial pH
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 58

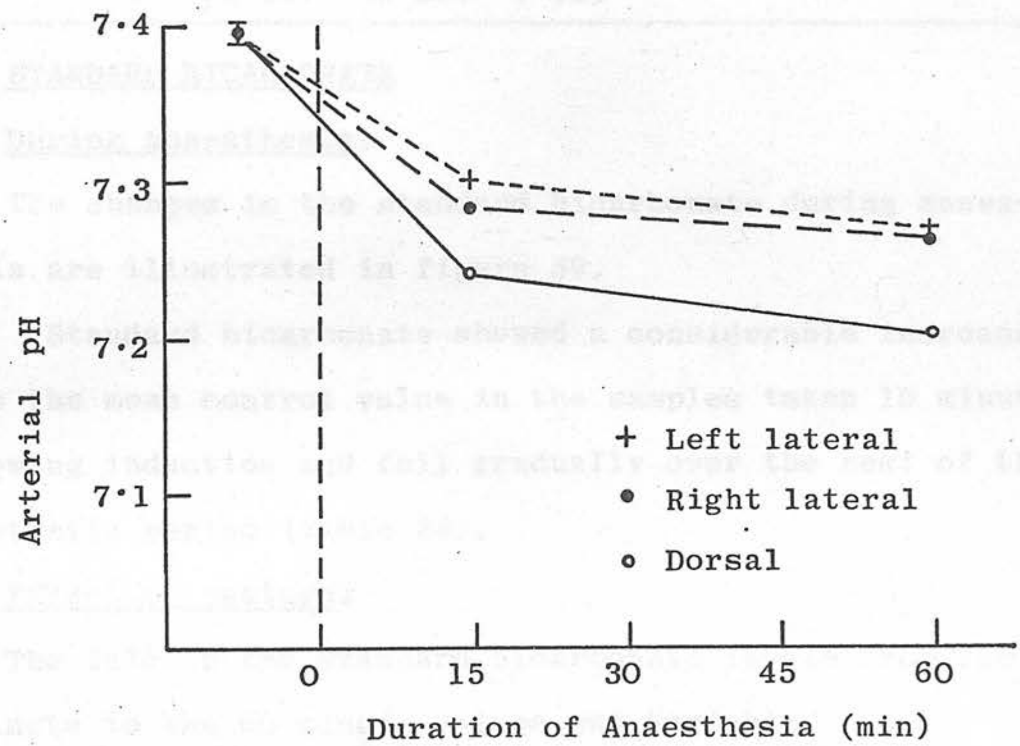

7·4
7·3
7·2
7·1
Arterial pH
+ Left lateral
• Right lateral
∘ Dorsal
0
15
30
45
60
Duration of Anaesthesia (min)

Table 27

Mean (± standard error) values for pH for total number of dogs in group A and for dogs grouped in different postures during anaesthesia.

No.of dogs	Posture	Control	Anaesthesia		t-value	Significance of deviation of 60 min value from control.
			15 min	60 min		
14	L.lat.	7·410 ±0·008	7·298 ±0·008	7·266 ±0·015	8·600	$P < 0·001$
16	R.lat.	7·387 ±0·015	7·282 ±0·011	7·261 ±0.015	7·882	$P < 0·001$
20	Dorsal	7·391 ±0·013	7·239 ±0·017	7·199 ±0·016	11·529	$P < 0·001$
50	Total	7·395 ±0·007	7·270 ±0·008	7·237 ±0·010	10·989	$P < 0·001$

6.3 STANDARD BICARBONATE

6.3a During anaesthesia:

The changes in the standard bicarbonate during anaesthesia are illustrated in figure 59.

Standard bicarbonate showed a considerable increase above the mean control value in the samples taken 15 minutes following induction and fell gradually over the rest of the anaesthetic period (table 28).

6.3b Effect of posture:

The fall in the standard bicarbonate levels from the 15 minute to the 60 minute values was variable in the differing postures but no significant difference could be demonstrated between the values of standard bicarbonate obtained in lateral and dorsal positions (figures 60 to 63).

Fig. 59

Placed in sequence, for comparison, below Fig. 49.

Fig. 60

Mean ($\pm$ standard error) values of standard bicarbonate of 14 clinical dogs in group A, in left lateral posture during 60 minutes of anaesthesia.

Fig. 61

Mean ($\pm$ standard error) values of standard bicarbonate of 16 clinical dogs in group A, in right lateral posture during 60 minutes of anaesthesia.

Fig. 60

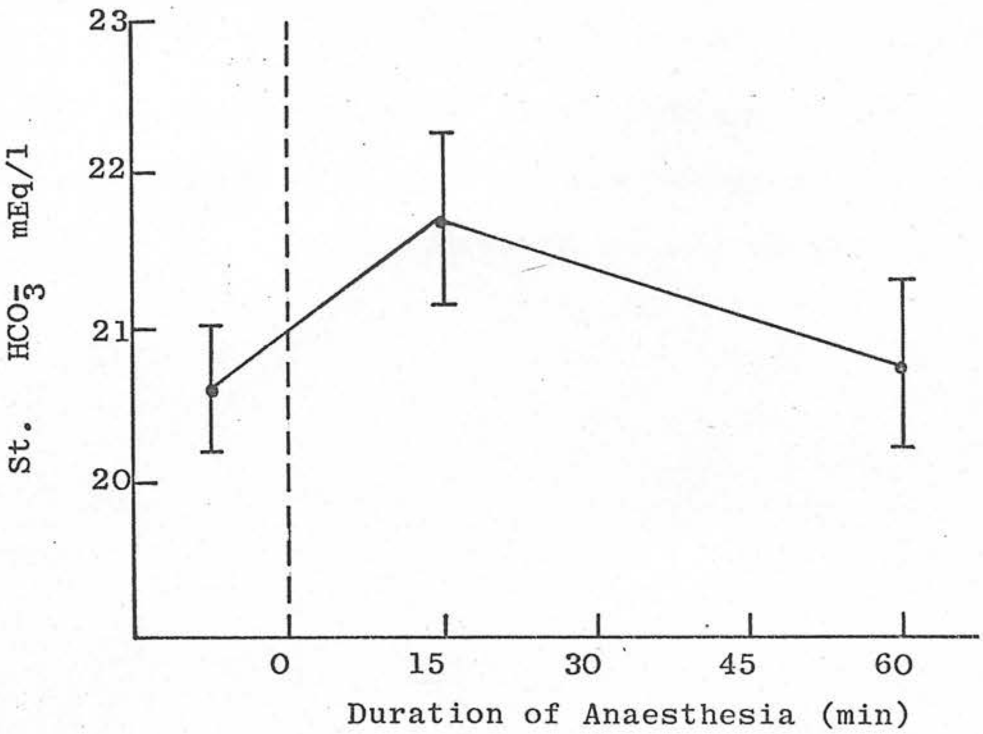

23
22
21
20
St. HCO$_3^-$ mEq/1
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 61

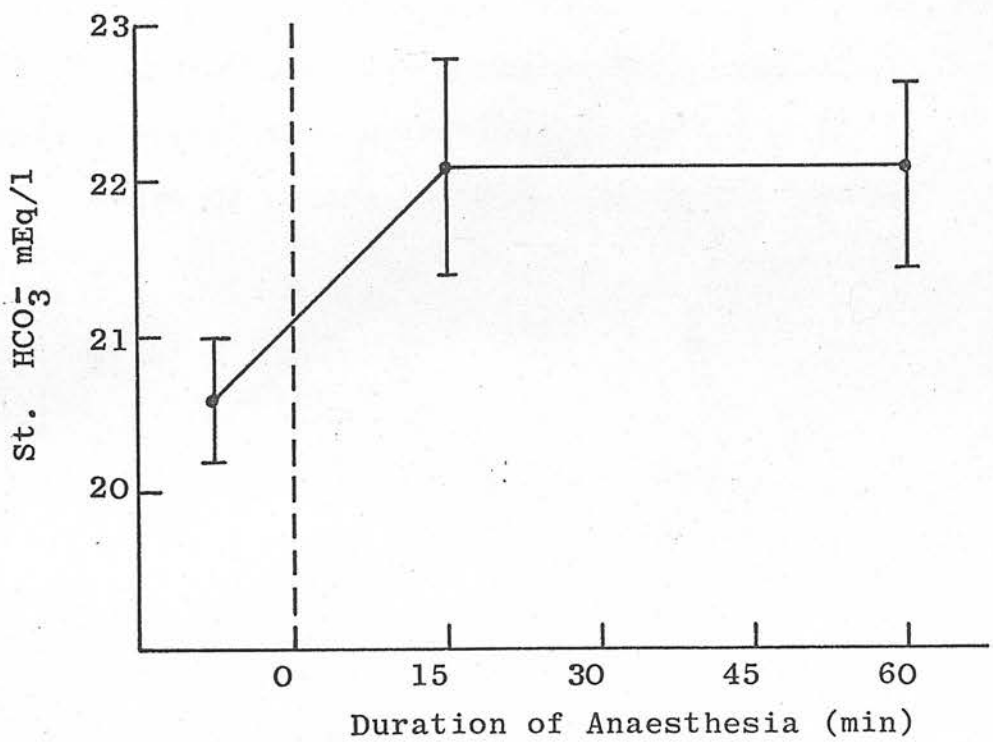

23
22
21
20
St. HCO$_3^-$ mEq/1
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 62

Mean ($\pm$ standard error) values of standard bicarbonate of 20 clinical dogs in group A in dorsal posture during 60 minutes of anaesthesia.

Fig. 63

Comparison of mean values of standard bicarbonate of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 62

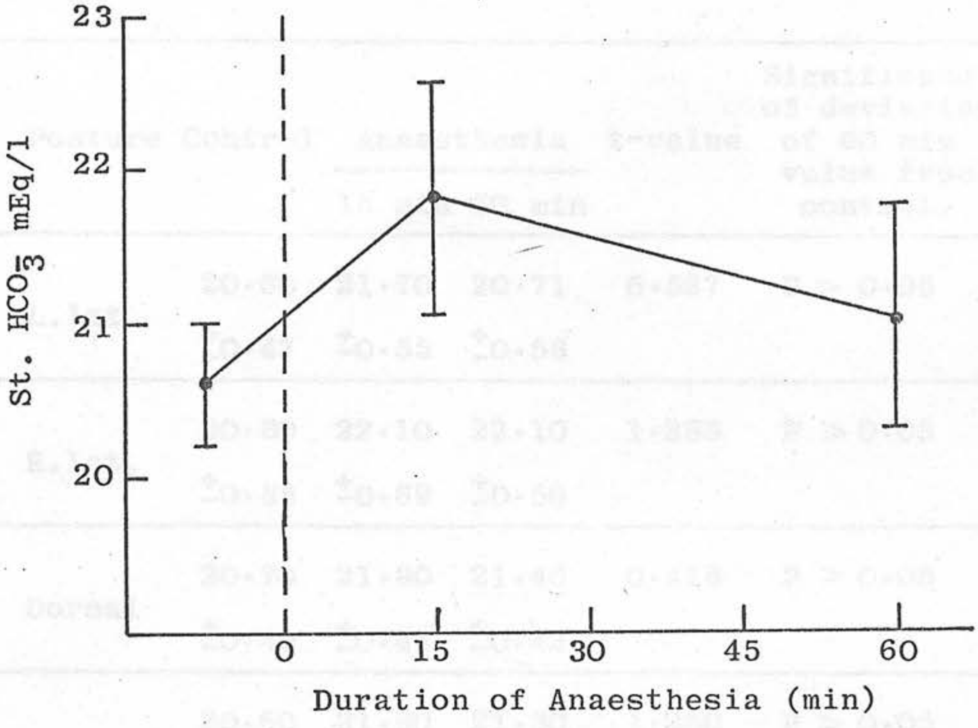

St. HCO3 mEq/1
23
22
21
20
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 63

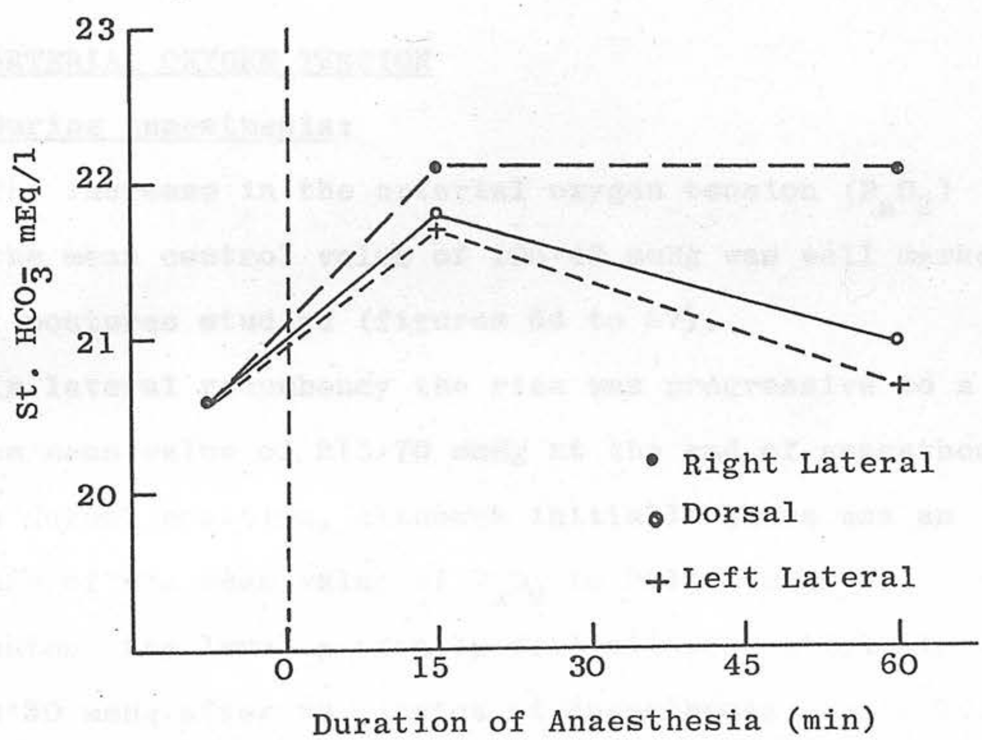

St. HCO3 mEq/1
23
22
21
20
Right Lateral
Dorsal
Left Lateral
0
15
30
45
60
Duration of Anaesthesia (min)

Table 28

Mean (± standard error) values for standard bicarbonate (mEq/l) for total number of dogs in group A and for dogs grouped in different postures during anaesthesia.

No.of dogs	Posture	Control	Anaesthesia 15 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control.
14	L.lat.	20·60 ±0·47	21·70 ±0·55	20·71 ±0·58	0·527	$P > 0{\cdot}05$
16	R.lat.	20·80 ±0·83	22·10 ±0·69	22·10 ±0·56	1·293	$P > 0{\cdot}05$
20	Dorsal	20·70 ±0·49	21·90 ±0·44	21·46 ±0·42	0·418	$P > 0{\cdot}05$
50	Total	20·60 ±0·37	21·80 ±0·39	21·30 ±0·40	1·250	$P > 0{\cdot}05$

6.4 ARTERIAL OXYGEN TENSION

6.4a During Anaesthesia:

The increase in the arterial oxygen tension (P_aO_2) from the mean control value of 105·43 mmHg was well marked in all postures studied (figures 64 to 67).

In lateral recumbency the rise was progressive to a maximum mean value of 215·70 mmHg at the end of anaesthesia. In the dorsal position, although initially there was an increase of the mean value of P_aO_2 to 201·60 mmHg at 15 minutes, the level gradually fell although still elevated at 163·20 mmHg after 60 minutes of anaesthesia (table 29).

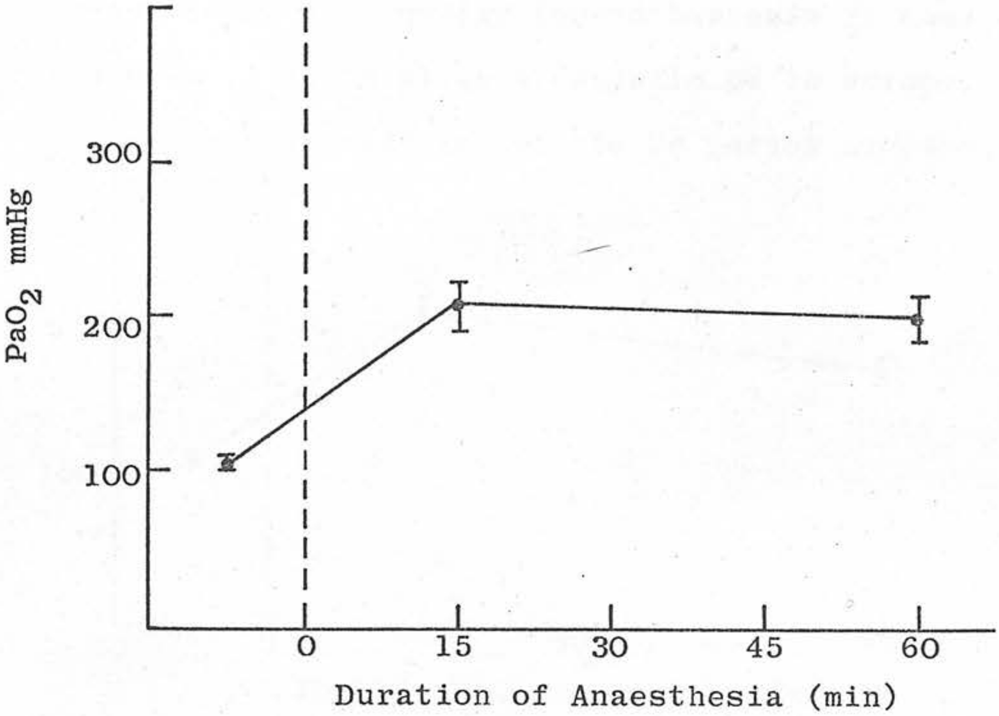
Fig. 64

Mean ($\pm$ standard error) values of arterial oxygen tension of 14 clinical dogs in group A, in left lateral posture during 60 minutes of anaesthesia.

Fig. 65

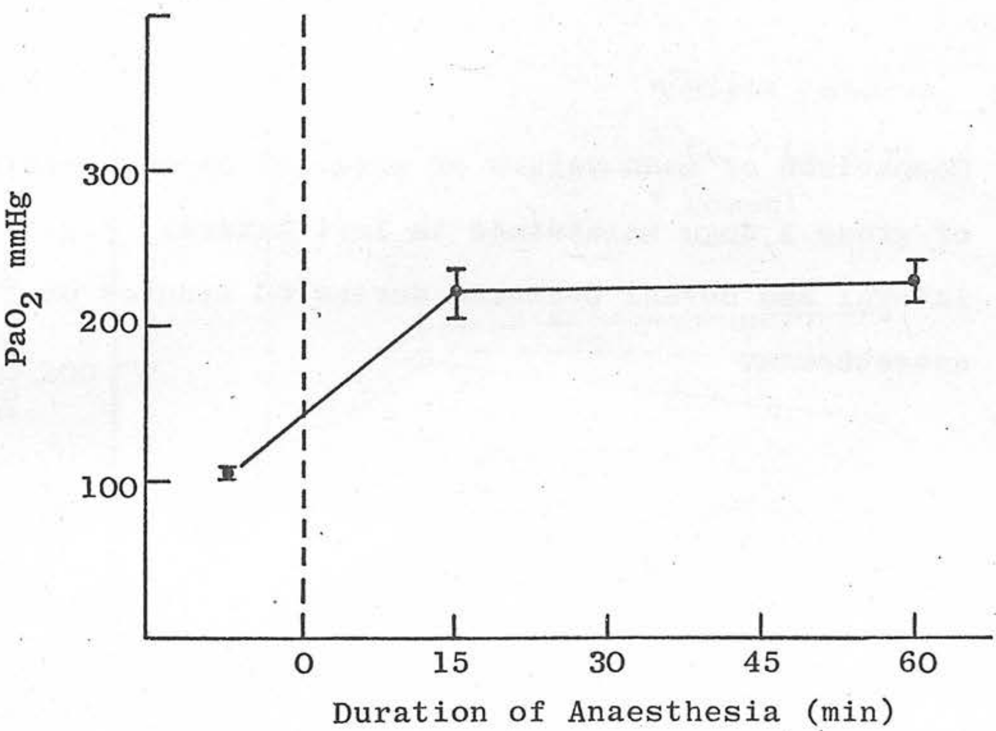
Mean ($\pm$ standard error) values of arterial oxygen tension of 16 clinical dogs in group A, in right lateral posture during 60 minutes of anaesthesia.

Fig. 64



PaO2 mmHg
300
200
100
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 65



PaO2 mmHg
300
200
100
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 66

Mean ($\pm$ standard error) values of arterial oxygen tension of 20 clinical dogs in group A, in dorsal posture during 60 minutes of anaesthesia.

Fig. 67

Comparison of mean values of arterial oxygen tension of group A dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 66

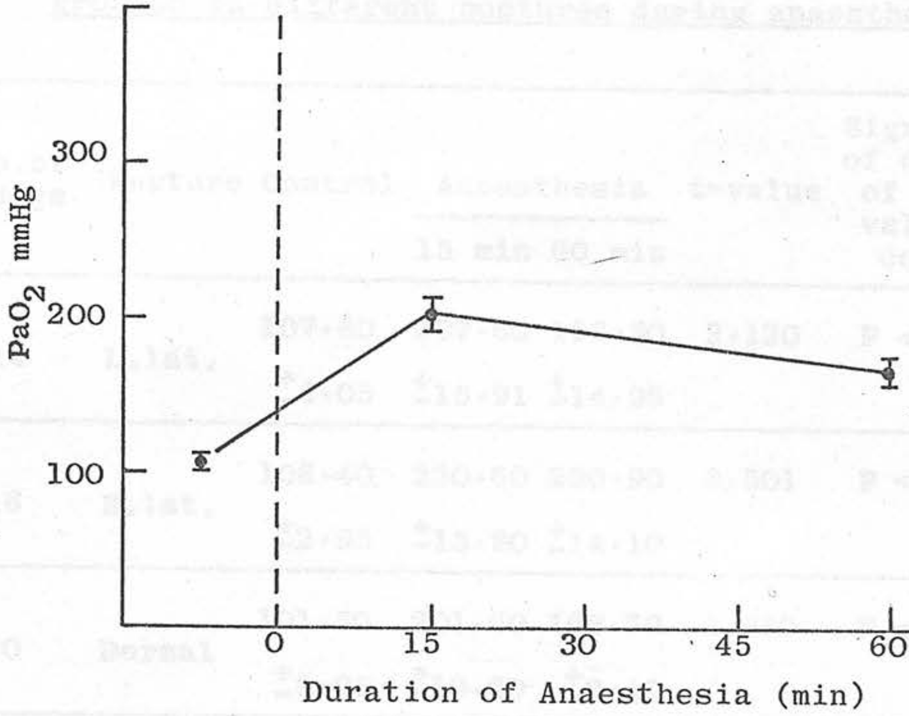

300
200
100
PaO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 67

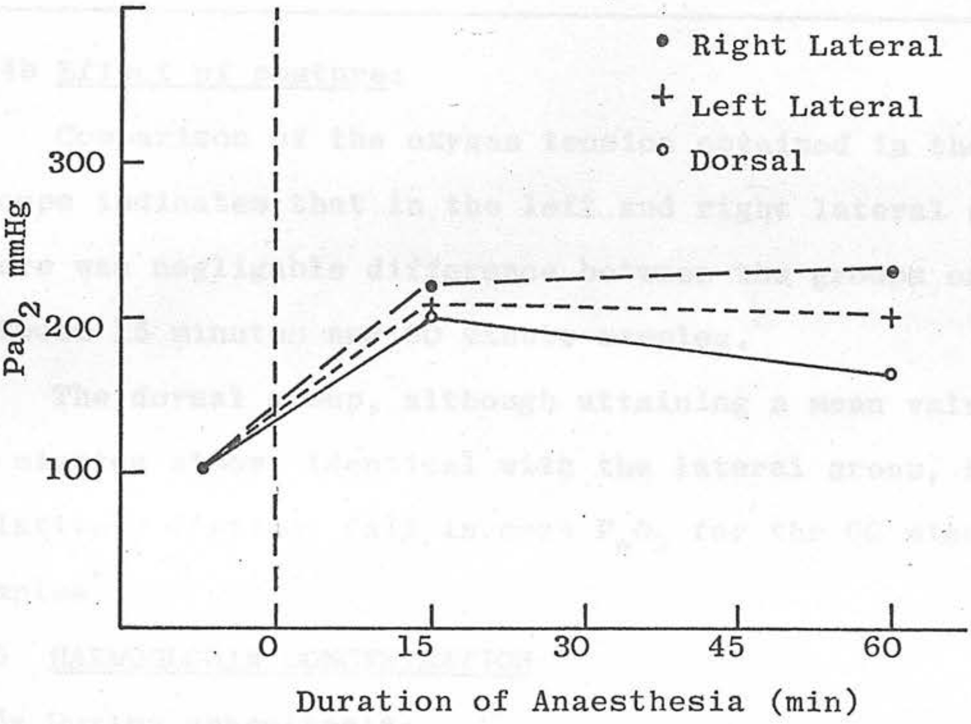

Right Lateral
Left Lateral
Dorsal
300
200
100
PaO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Table 29

Mean (± standard error) values for P_aO_2 (mmHg) for total number of dogs in group A and for dogs grouped in different postures during anaesthesia.

No.of dogs	Posture	Control	Anaesthesia 15 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control.
14	L.lat.	107·60 ±4·05	207·60 ±15·91	198·30 ±14·96	3·120	$P < 0·001$
16	R.lat.	108·40 ±2·95	220·60 ±13·90	230·90 ±14·10	8·501	$P < 0·001$
20	Dorsal	101·50 ±3·95	201·60 ±10·60	163·20 ±9·49	5·990	$P < 0·001$
50	Total	105·43 ±2·17	209·35 ±7·67	194·68 ±8·17	10·550	$P < 0·001$

6.4b <u>Effect of posture</u>:

Comparison of the oxygen tension obtained in the three groups indicates that in the left and right lateral postures there was negligable difference between the groups or between 15 minutes and 60 minute samples.

The dorsal group, although attaining a mean value at 15 minutes almost identical with the lateral group, had a relatively distinct fall in mean P_aO_2 for the 60 minute samples.

6.5 HAEMOGLOBIN CONCENTRATION

6.5a <u>During anaesthesia</u>:

The influence of anaesthesia on the haemoglobin concentration is shown in figures 68 to 71. A significant

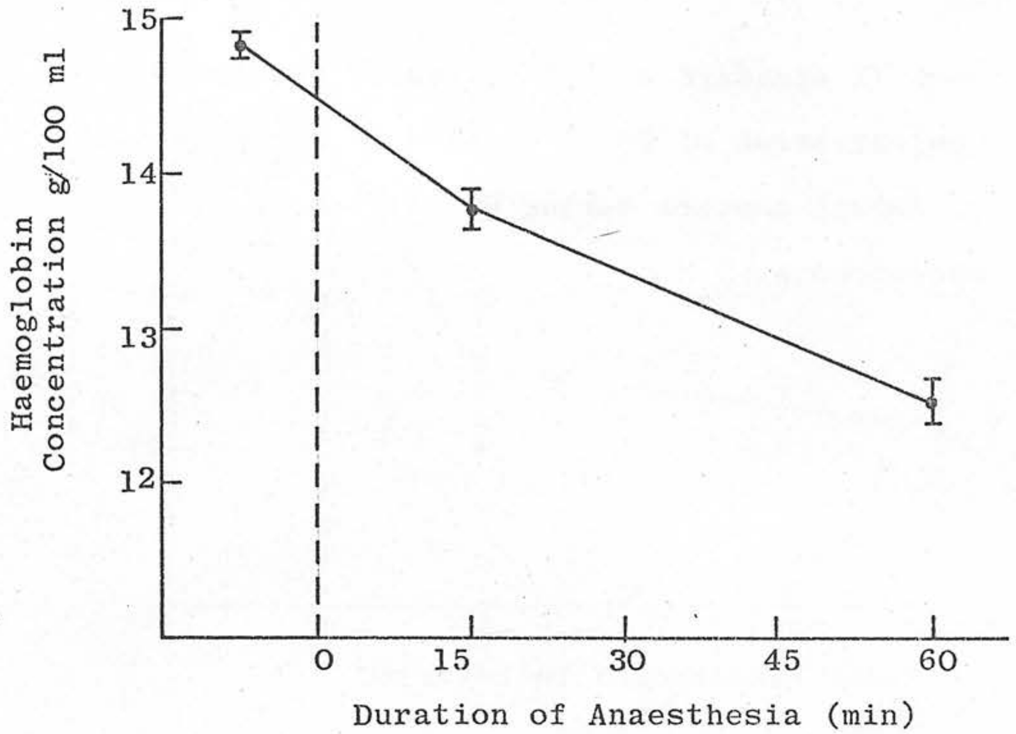
Fig. 68

Mean (± standard error) values of haemoglobin concentration of 14 clinical dogs in group A, in left lateral posture during 60 minutes of anaesthesia.

Fig. 69

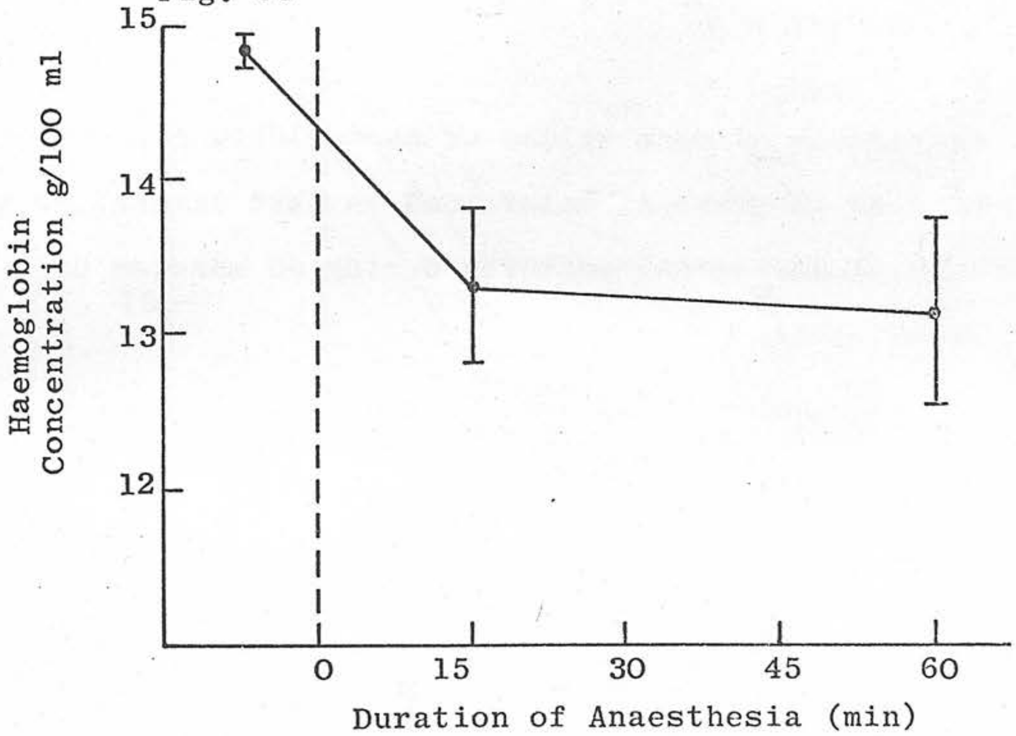
Mean (± standard error) values of haemoglobin concentration of 16 clinical dogs in group A, in right lateral posture during 60 minutes of anaesthesia.

Fig. 68



15
14
13
12
Haemoglobin
Concentration g/100 ml
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 69



15
14
13
12
Haemoglobin
Concentration g/100 ml
0
15
30
45
60
Duration of Anaesthesia (min)

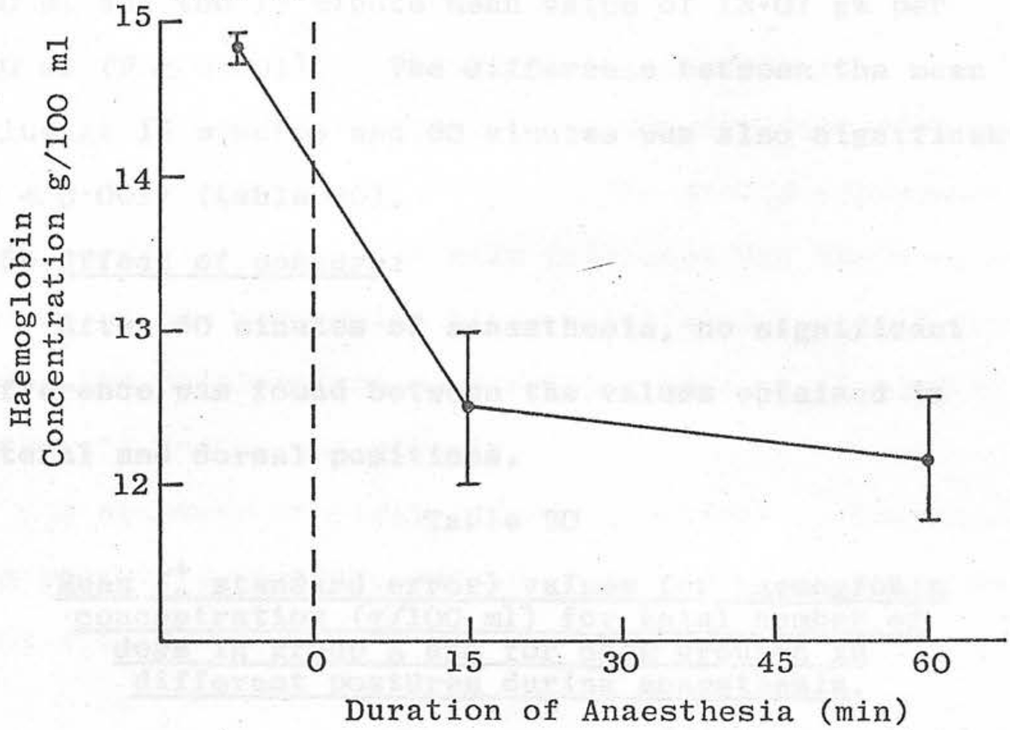
Fig. 70

Mean (± standard error) values of haemoglobin concentration of 20 clinical dogs in group A, in dorsal posture during 60 minutes of anaesthesia.

Fig. 71

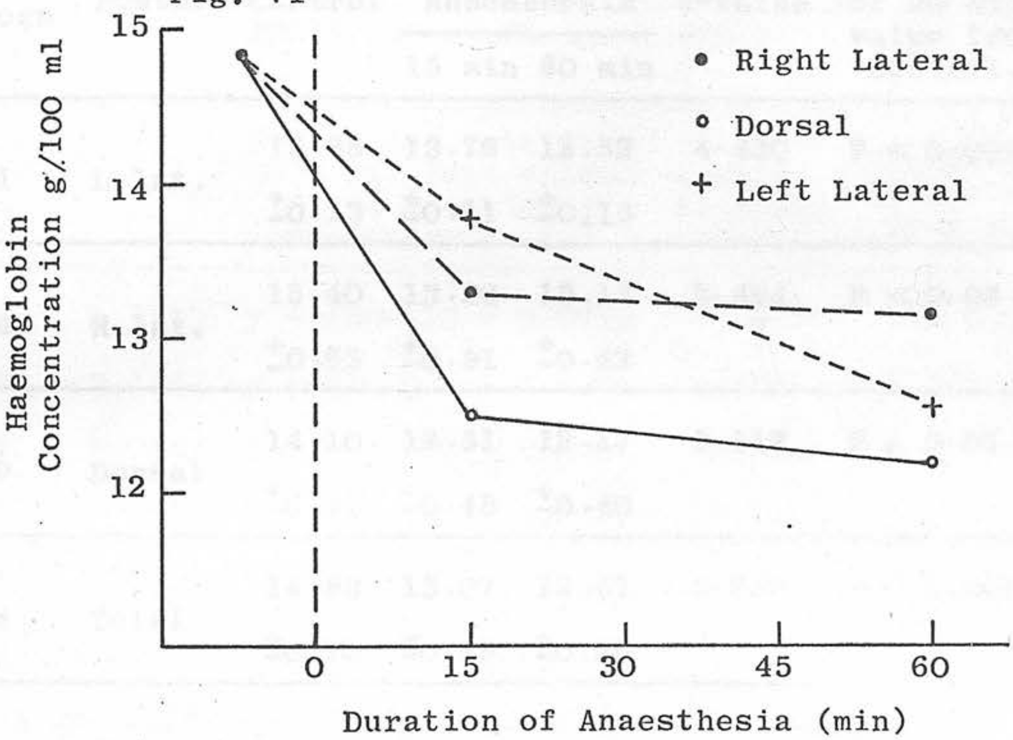
Comparison of mean values of haemoglobin concentration of dogs in group A, maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 70



15
14
13
12
Haemoglobin
Concentration g/100 ml
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 71



15
14
13
12
Haemoglobin
Concentration g/100 ml
● Right Lateral
o Dorsal
+ Left Lateral
0
15
30
45
60
Duration of Anaesthesia (min)

decrease was demonstrable between the haemoglobin concentration of the mean control value of 14·83 gm per 100 ml and the 15 minute mean value of 13·07 gm per 100 ml ($P < 0{\cdot}001$). The difference between the mean value at 15 minutes and 60 minutes was also significant ($P < 0{\cdot}001$) (table 30).

6.5b Effect of posture:

After 60 minutes of anaesthesia, no significant difference was found between the values obtained in lateral and dorsal positions.

Table 30

Mean ($\pm$ standard error) values for haemoglobin concentration (g/100 ml) for total number of dogs in group A and for dogs grouped in different postures during anaesthesia.

No. of dogs	Posture	Control	Anaesthesia 15 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control.
11	L.lat.	15·38 $\pm$0·13	13·76 $\pm$0·11	12·52 $\pm$0·15	4·420	$P < 0{\cdot}001$
14	R.lat.	15·40 $\pm$0·65	13·30 $\pm$0·51	13·15 $\pm$0·62	2·494	$P < 0{\cdot}05$
19	Dorsal	14·10 $\pm$0·47	12·51 $\pm$0·48	12·17 $\pm$0·40	3·118	$P < 0{\cdot}01$
44	Total	14·83 $\pm$0·10	13·07 $\pm$0·28	12·57 $\pm$0·29	5·256	$P < 0{\cdot}001$

EXPERIMENTAL DOGS

7.0 PHYSIOLOGICAL PARAMETERS

7.1 TIDAL VOLUME

7.1a Changes of Tidal Volume during anaesthesia:

Changes in tidal volume over the duration of anaesthesia are shown in figure 72. The pooled regression line is derived from the mean intercept and the mean slope values of the regression lines calculated for each animal using the tidal volume measurements made at 15 minute intervals during anaesthesia.

A decrease of tidal volume is evident as anaesthesia was prolonged, but the extent of the fall was not significant (table 31).

Table 31

Relationship of tidal volume (ml) to duration of anaesthesia (min) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No. of dogs	Posture	Regression relationship of tidal volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 180{\cdot}125 - 0{\cdot}077x$	$-0{\cdot}279$	$P > 0{\cdot}05$
8	R.lat.	$y = 210{\cdot}063 - 0{\cdot}450x$	$-1{\cdot}870$	$P > 0{\cdot}05$
8	Dorsal	$y = 175{\cdot}500 + 0{\cdot}270x$	$+0{\cdot}550$	$P > 0{\cdot}05$
24	Total	$y = 188{\cdot}562 - 0{\cdot}041x$	$-0{\cdot}202$	$P > 0{\cdot}05$

The effect of the animal's posture on the changes of tidal volume is shown in figures 73 to 76, in which the mean values $\pm$ the standard error are plotted for each 15 minute time increment. The pooled regression lines derived for each posture are shown in figure 77. All

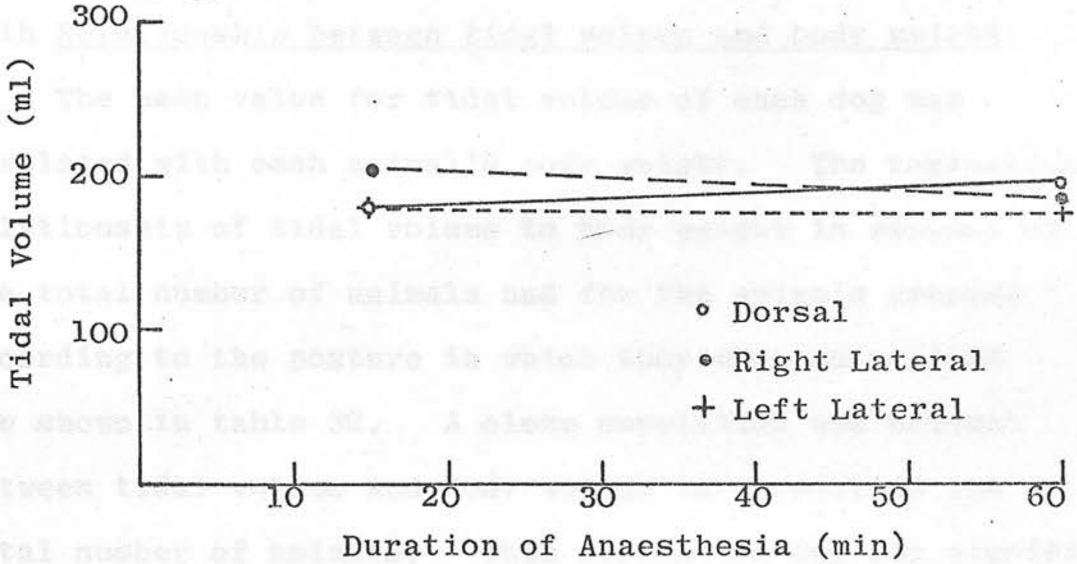
Fig. 77

Comparison of the behaviour of tidal volume of the experimental dogs in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 72

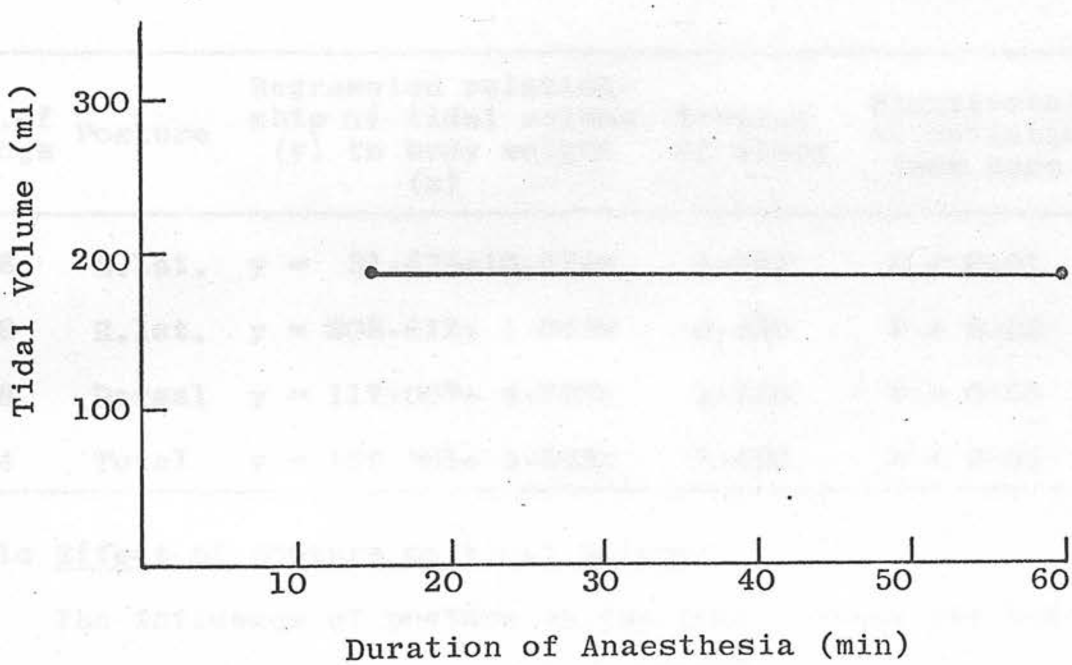
Behaviour of tidal volume of the experimental dogs during 60 minutes of anaesthesia.

Fig. 77



300
200
100
Tidal Volume (ml)
o Dorsal
• Right Lateral
+ Left Lateral
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 72



300
200
100
Tidal Volume (ml)
10
20
30
40
50
60
Duration of Anaesthesia (min)

the subgroups showed a tendency for the tidal volume to decrease during anaesthesia except for the dorsal posture (table 31).

7.1b <u>Relationship between tidal volume and body weight</u>:

The mean value for tidal volume of each dog was corelated with each animal's body weight. The regression relationship of tidal volume to body weight in respect of the total number of animals and for the animals grouped according to the posture in which they were maintained are shown in table 32. A close corelation was evident between tidal volume and body weight in respect of the total number of animals. This corelation was not significant in right lateral and dorsal postures.

Table 32

<u>Relationship of tidal volume (ml) to body weight (kg) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.</u>

No.of dogs	Posture	Regression relationship of tidal volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 31{\cdot}675+10{\cdot}674x$	4·724	$P < 0{\cdot}01$
8	R.lat.	$y = 208{\cdot}612+1{\cdot}043x$	0·188	$P > 0{\cdot}05$
8	Dorsal	$y = 117{\cdot}007+4{\cdot}798x$	1·110	$P > 0{\cdot}05$
24	Total	$y = 109{\cdot}301+5{\cdot}503x$	2·490	$P < 0{\cdot}05$

7.1c <u>Effect of posture on tidal volume</u>:

The influence of posture on the tidal volume was tested by comparing the regression lines shown in table 32. There was no significant difference between left lateral, right lateral and dorsal postures.

Fig. 73

Mean (± standard error) values of tidal volume of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 74

Mean (± standard error) values of tidal volume of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 73

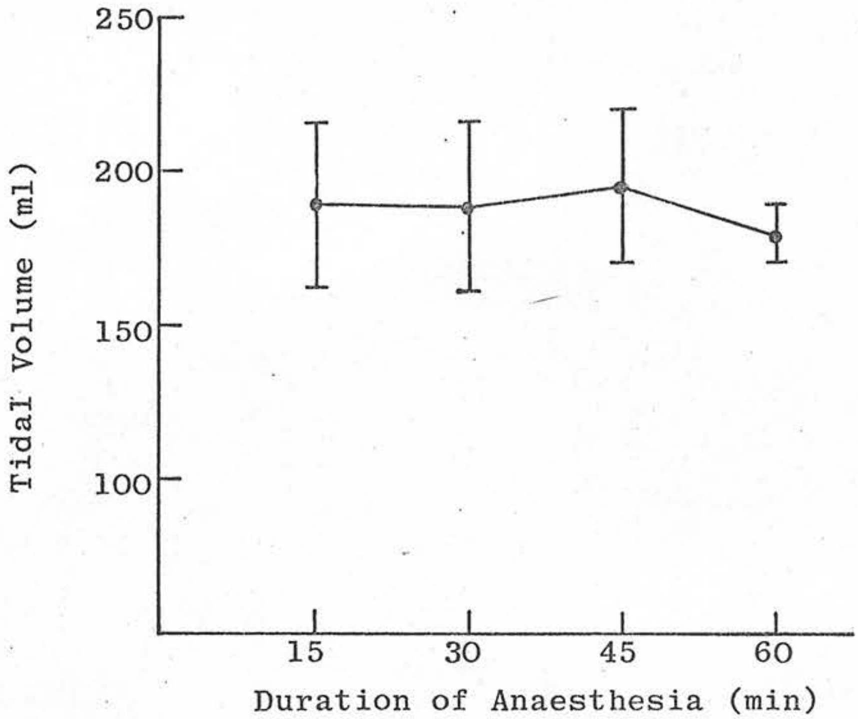

250
200
150
100
Tidal Volume (ml)
15
30
45
60
Duration of Anaesthesia (min)

Fig. 74

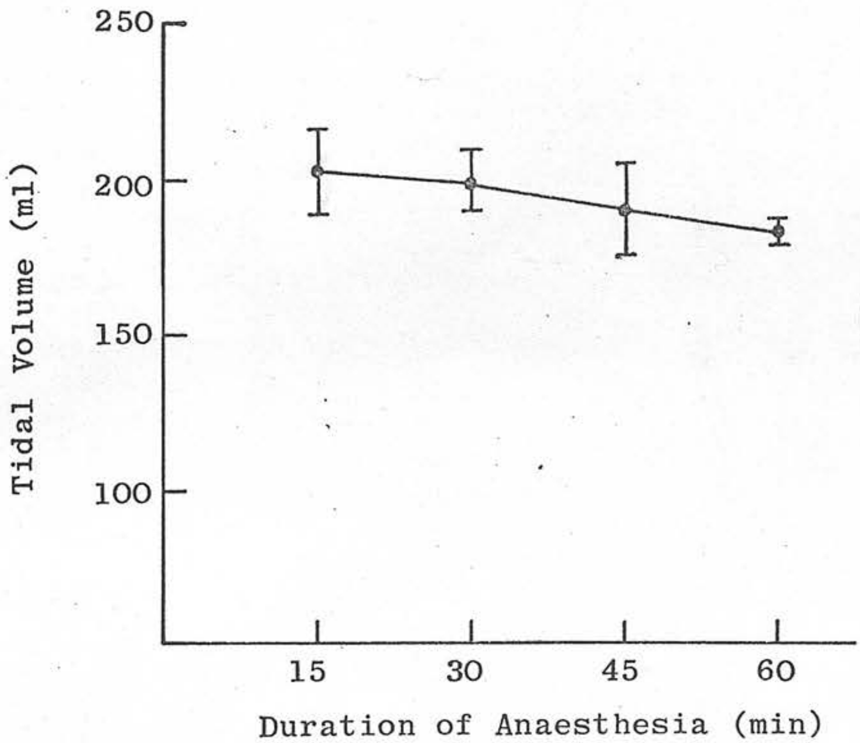

250
200
150
100
Tidal Volume (ml)
15
30
45
60
Duration of Anaesthesia (min)

Fig. 75

Mean ($\pm$ standard error) values of tidal volume of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

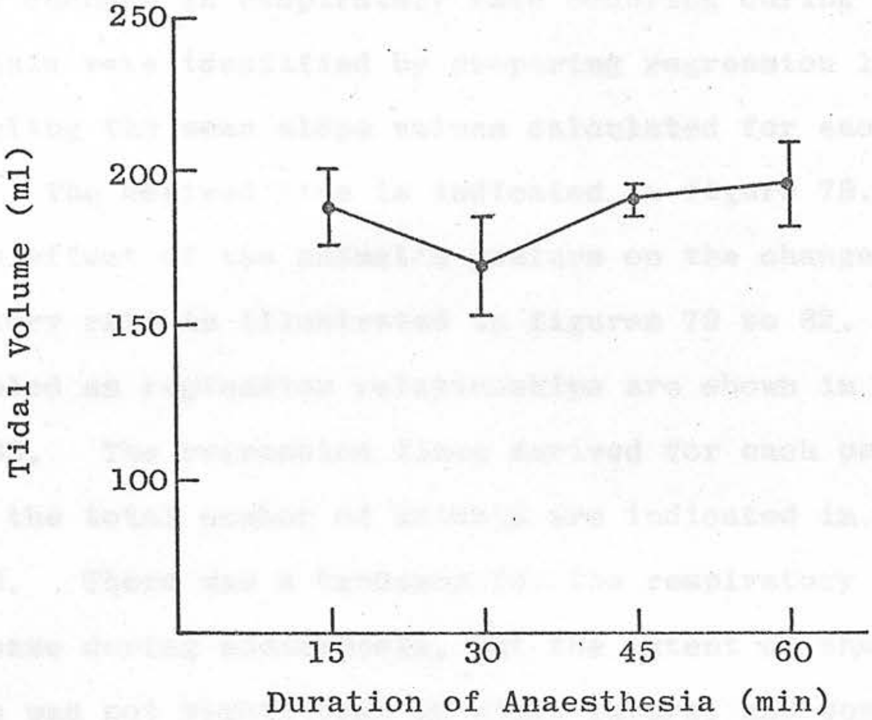
Fig. 76

Comparison of mean values of tidal volume of experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 77

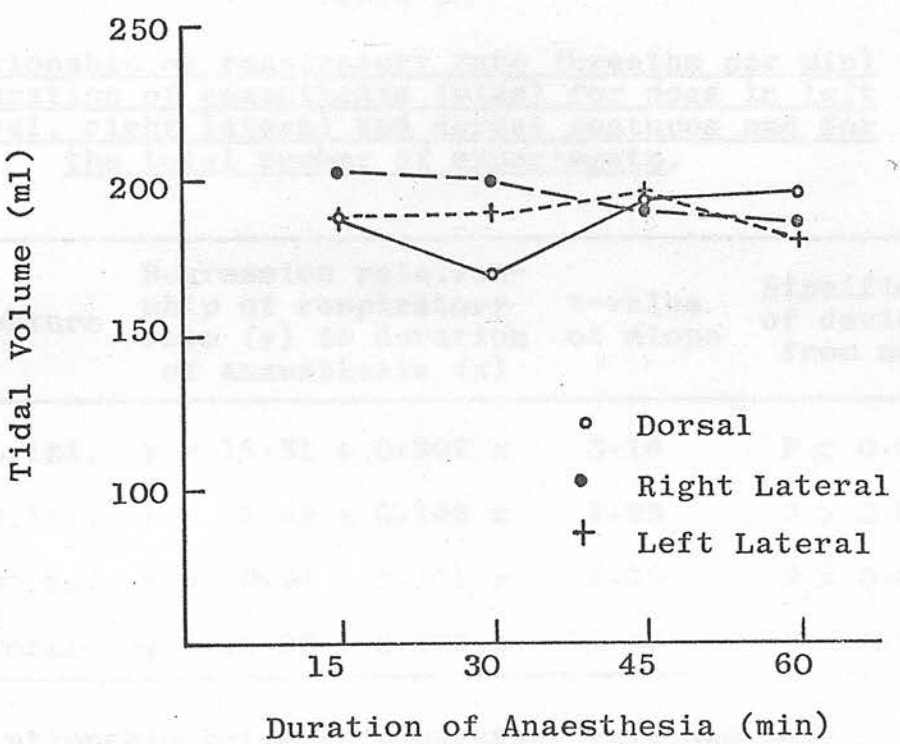
Placed in sequence, for comparison, above Fig. 72.

Fig. 75



250
200
150
100
Tidal Volume (ml)
15
30
45
60
Duration of Anaesthesia (min)

Fig. 76



250
200
150
100
Tidal Volume (ml)
Dorsal
Right Lateral
Left Lateral
15
30
45
60
Duration of Anaesthesia (min)

7.2 RESPIRATORY RATE

7.2a Changes of respiratory rate during anaesthesia:

The changes in respiratory rate occuring during anaesthesia were identified by preparing regression lines from pooling the mean slope values calculated for each animal. The derived line is indicated in figure 78.

The effect of the animal's posture on the change of respiratory rate is illustrated in figures 79 to 82. The data pooled as regression relationships are shown in figure 83. The regression lines derived for each posture and for the total number of animals are indicated in table 33. There was a tendency for the respiratory rate to increase during anaesthesia, but the extent of the increase was not significant in right lateral and dorsal postures.

Table 33

Relationship of respiratory rate (breaths per min) to duration of anaesthesia (mins) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No. of dogs	Posture	Regression relationship of respiratory rate (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 16{\cdot}31 + 0{\cdot}207\,x$	3·16	$P < 0{\cdot}05$
8	R.lat.	$y = 12{\cdot}69 + 0{\cdot}149\,x$	1·93	$P > 0{\cdot}05$
8	Dorsal	$y = 9{\cdot}94 + 0{\cdot}161\,x$	2·29	$P > 0{\cdot}05$
24	Total	$y = 12{\cdot}98 + 0{\cdot}172\,x$	5·38	$P < 0{\cdot}001$

7.2b Relationship between respiratory rate and body weight:

The mean value for respiratory rate of each dog was corelated with each animal's body weight. The regression

Fig. 83

Comparison of the behaviour of respiratory rate of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 78

Behaviour of the respiratory rate of the experimental dogs during 60 minutes of anaesthesia.

Fig. 83

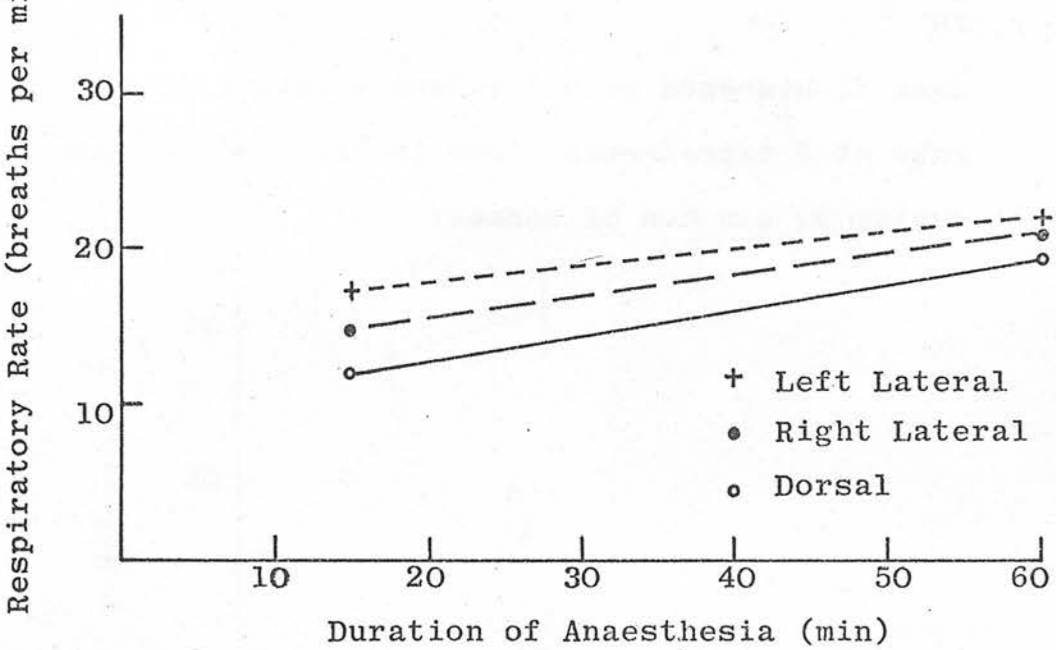

Respiratory Rate (breaths per min)
30
20
10
+ Left Lateral
• Right Lateral
o Dorsal
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 78

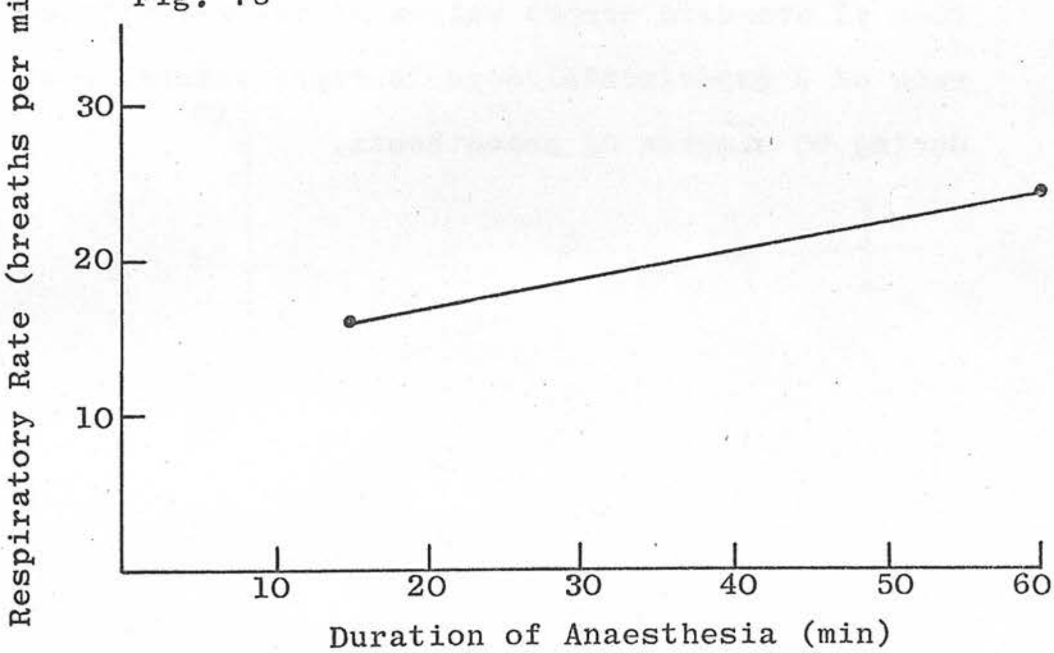

Respiratory Rate (breaths per min)
30
20
10
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 79

Mean (± standard error) values of the respiratory rate of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 80

Mean (± standard error) values of the respiratory rate of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 79

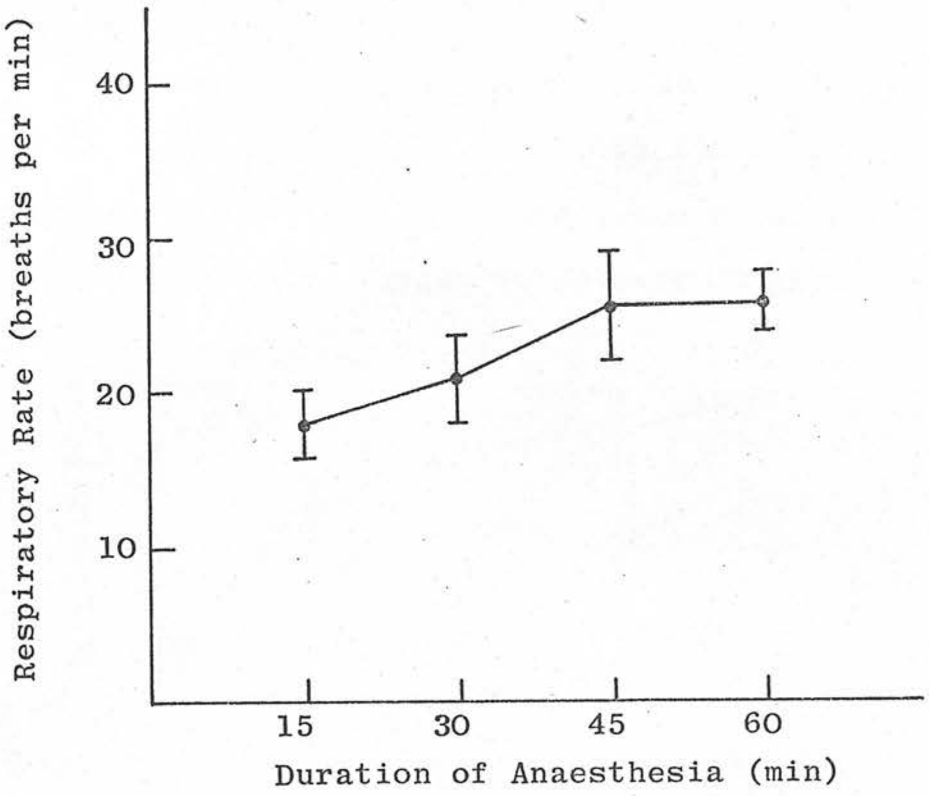

Respiratory Rate (breaths per min)
40
30
20
10
15
30
45
60
Duration of Anaesthesia (min)

Fig. 80

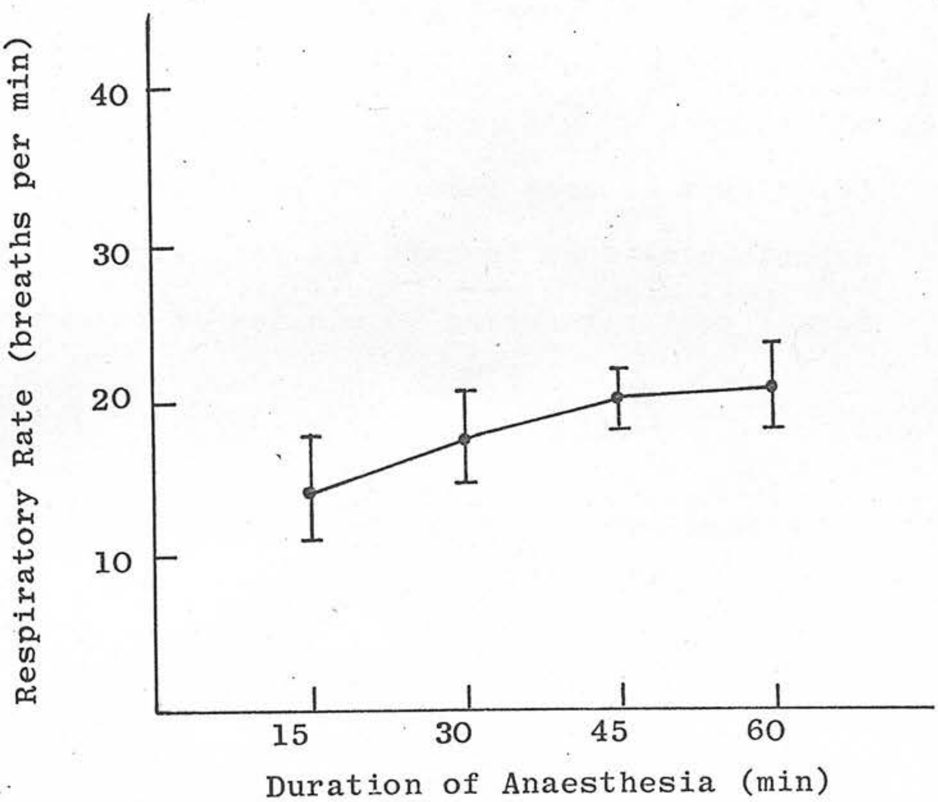

Respiratory Rate (breaths per min)
40
30
20
10
15
30
45
60
Duration of Anaesthesia (min)

Fig. 81

Mean ($\pm$ standard error) values of the respiratory rate of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

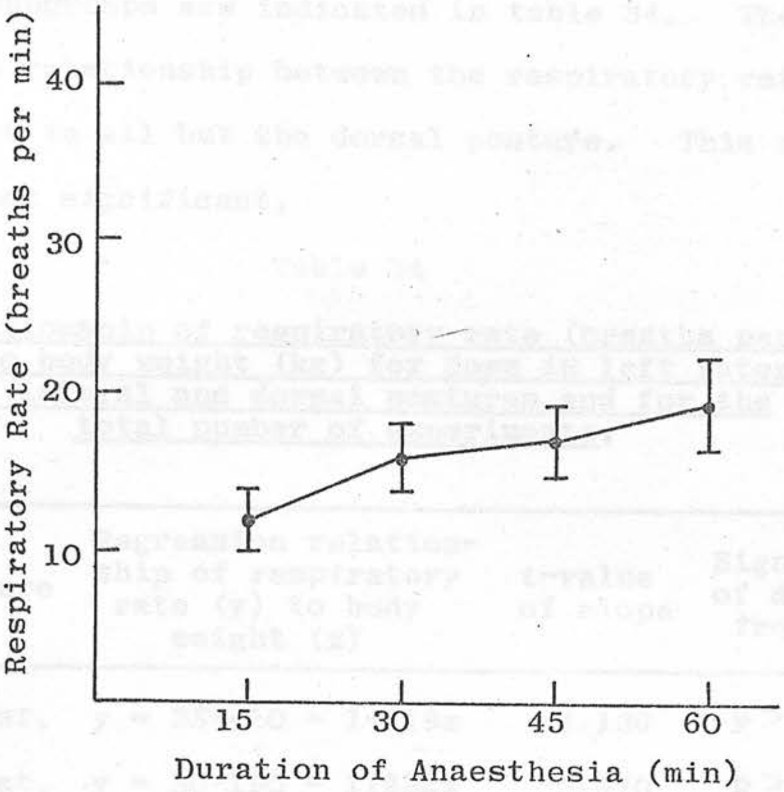
Fig. 82

Comparison of mean values of respiratory rate of the experimental dogs in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 83

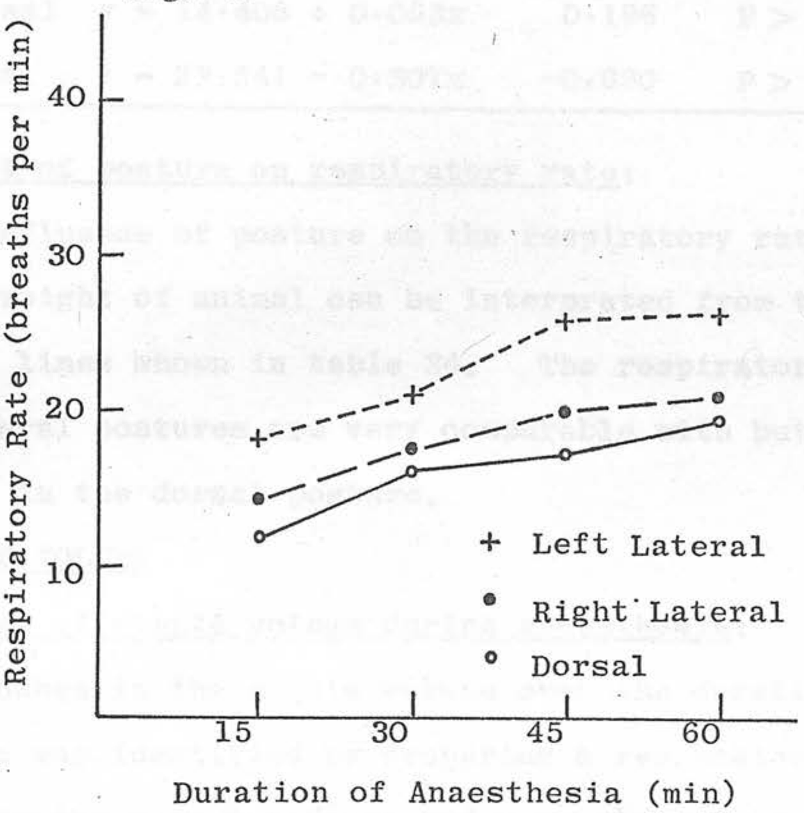
Placed in sequence, for comparison, above Fig. 78.

Fig. 81



Respiratory Rate (breaths per min)
40
30
20
10
15
30
45
60
Duration of Anaesthesia (min)

Fig. 82



Respiratory Rate (breaths per min)
40
30
20
10
+ Left Lateral
• Right Lateral
° Dorsal
15
30
45
60
Duration of Anaesthesia (min)

relationship for the total number of animals and for the postural subgroups are indicated in table 34. There was an inverse relationship between the respiratory rate and body weight in all but the dorsal posture. This relationship was not significant.

Table 34

Relationship of respiratory rate (breaths per min) to body weight (kg) for dogs in left lateral right lateral and dorsal postures and for the total number of experiments.

No. of dogs	Posture	Regression relationship of respiratory rate (y) to body weight (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 38 \cdot 410 - 1 \cdot 619x$	$-2 \cdot 136$	$P > 0 \cdot 05$
8	R.lat.	$y = 30 \cdot 190 - 1 \cdot 282x$	$-0 \cdot 670$	$P > 0 \cdot 05$
8	Dorsal	$y = 14 \cdot 406 + 0 \cdot 093x$	$0 \cdot 196$	$P > 0 \cdot 05$
24	Total	$y = 23 \cdot 541 - 0 \cdot 307x$	$-0 \cdot 880$	$P > 0 \cdot 05$

7.2c Effect of posture on respiratory rate:

The influence of posture on the respiratory rate for any given weight of animal can be interpreted from the regression lines shown in table 34. The respiratory rate in the lateral postures are very comparable with but generally higher than in the dorsal posture.

7.3 MINUTE VOLUME

7.3a Changes of minute volume during anaesthesia:

The change in the minute volume over the duration of anaesthesia was identified by preparing a regression line from pooling the mean intercept and mean slope values calculated for each animal. The derived line is indicated in figure 84. Minute volume showed a progressive increase

Fig. 89

Comparison of the behaviour of minute volume of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 84

Behaviour of minute volume of the experimental dogs during 60 minutes of anaesthesia.

Fig. 89

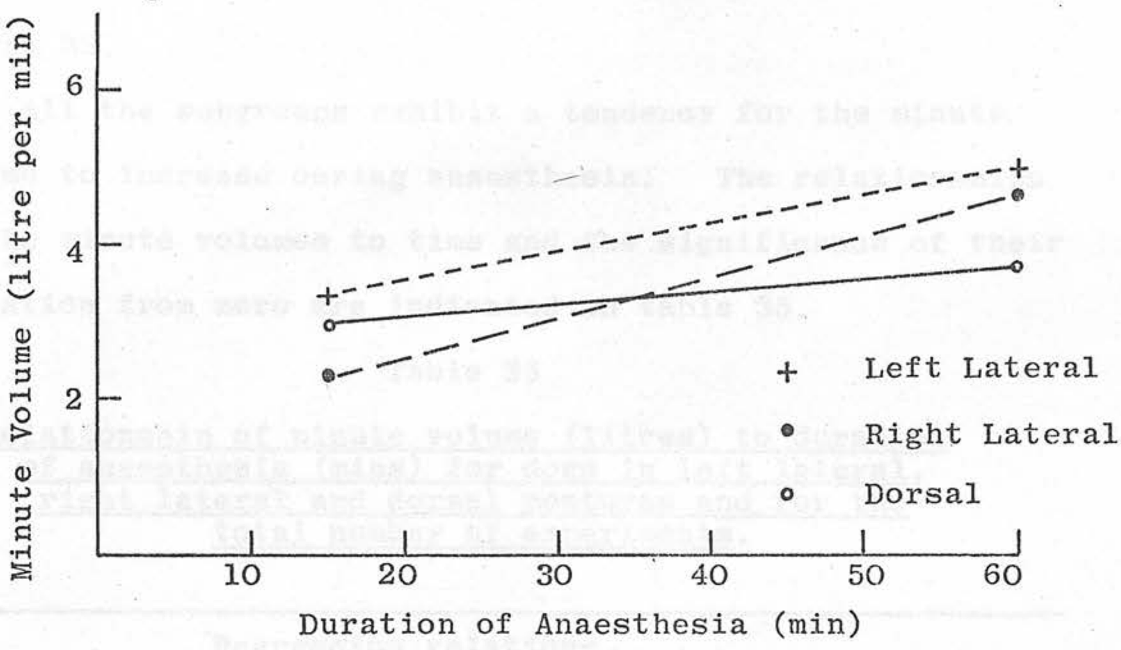
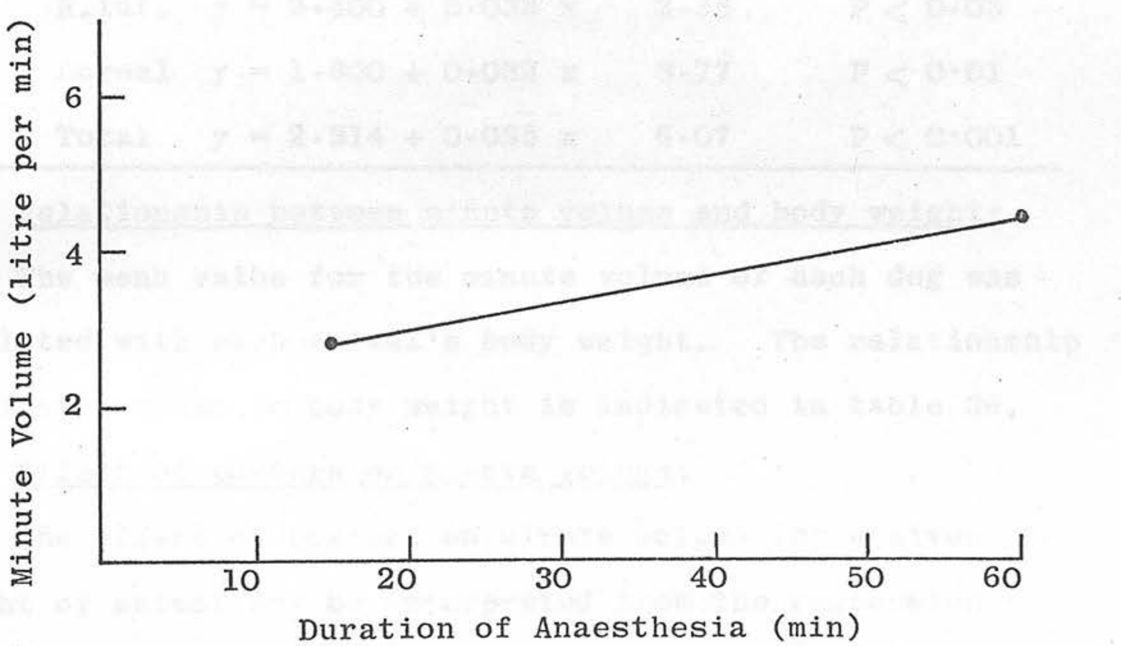

Minute Volume (litre per min)
6
4
2
10
20
30
40
50
60
Duration of Anaesthesia (min)
Left Lateral
Right Lateral
Dorsal

Fig. 84


Minute Volume (litre per min)
6
4
2
10
20
30
40
50
60
Duration of Anaesthesia (min)

over 60 minutes of anaesthesia as in groups A and B.

The effect of the animal's posture on the change of minute volume is illustrated in figures 85 to 88, and the data pooled as regression relationships is shown in figure 89.

All the subgroups exhibit a tendency for the minute volume to increase during anaesthesia. The relationships of the minute volumes to time and the significance of their deviation from zero are indicated in table 35.

Table 35

<u>Relationship of minute volume (litres) to duration of anaesthesia (mins) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.</u>

No. of dogs	Posture	Regression relationship of minute volume (y) to duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 2{\cdot}740 + 0{\cdot}035\ x$	7·23	$P < 0{\cdot}001$
8	R.lat.	$y = 2{\cdot}400 + 0{\cdot}038\ x$	2·55	$P < 0{\cdot}05$
8	Dorsal	$y = 1{\cdot}800 + 0{\cdot}032\ x$	3·77	$P < 0{\cdot}01$
24	Total	$y = 2{\cdot}314 + 0{\cdot}035\ x$	6·07	$P < 0{\cdot}001$

7.3b <u>Relationship between minute volume and body weight</u>:

The mean value for the minute volume of each dog was corelated with each animal's body weight. The relationship of minute volume to body weight is indicated in table 36.

7.3c <u>Effect of posture on minute volume</u>:

The effect of posture on minute volume for a given weight of animal may be interpreted from the regression lines shown in table 36. The minute volume in the lateral postures are very comparable, but generally, slightly higher than in the dorsal posture.

Fig. 85

Mean (± standard error) values of minute volume of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 86

Mean (± standard error) values of minute volume of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 85

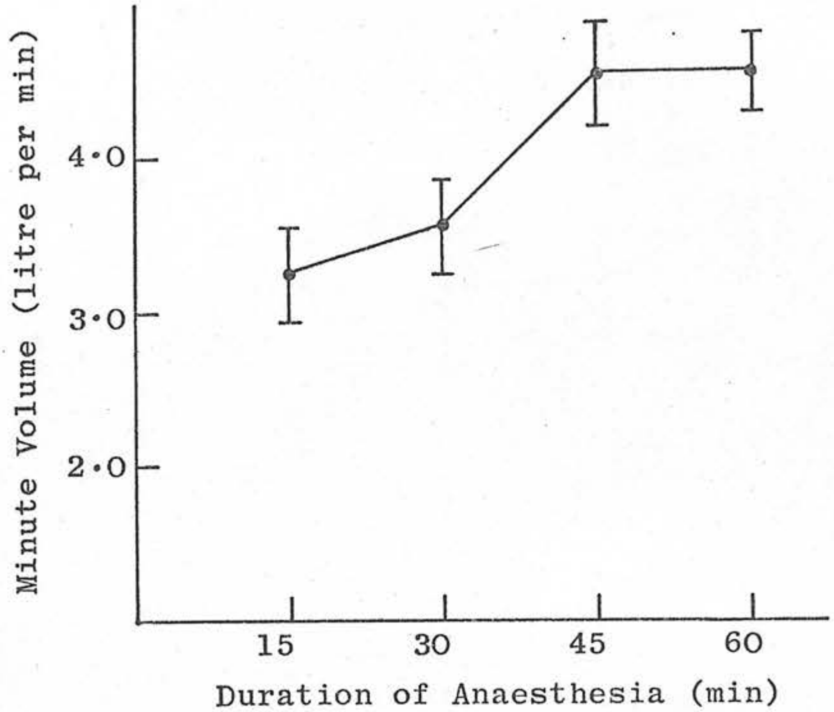

Minute Volume (litre per min)
4·0
3·0
2·0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 86

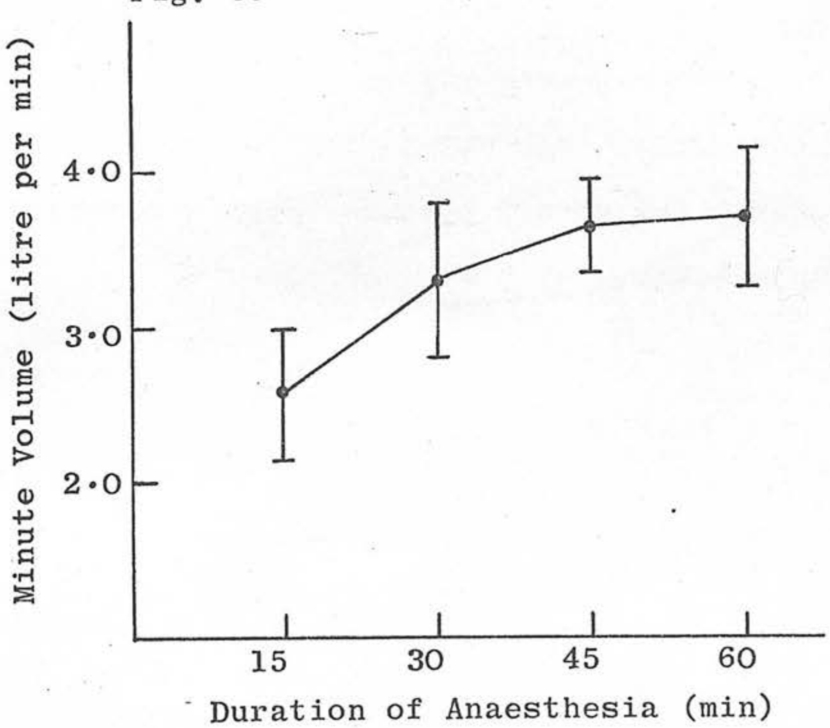

Minute Volume (litre per min)
4·0
3·0
2·0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 87

Mean ($\pm$ standard error) values of minute volume of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

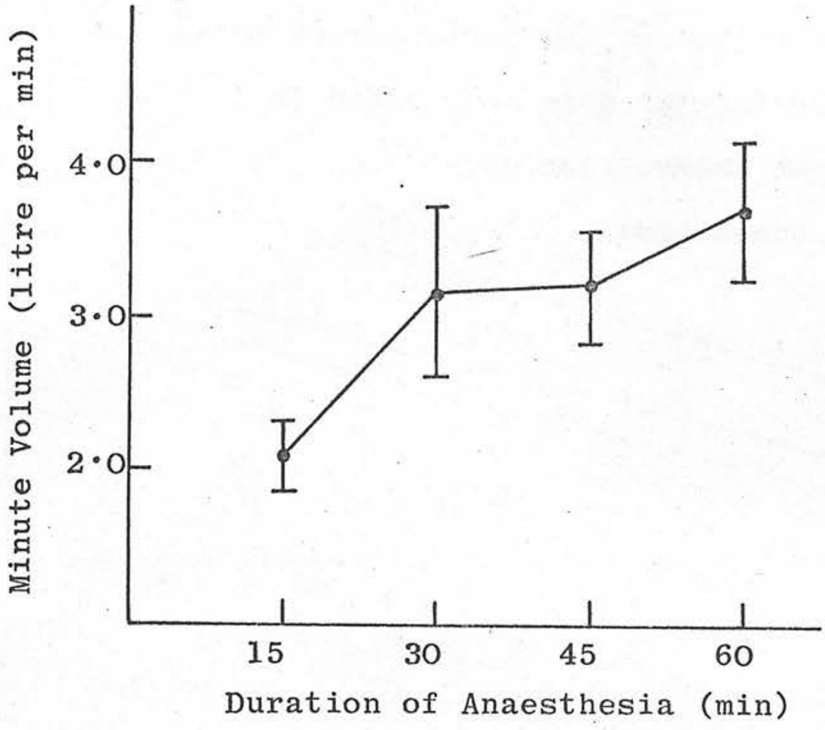
Fig. 88

Comparison of mean values of minute volume of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 89

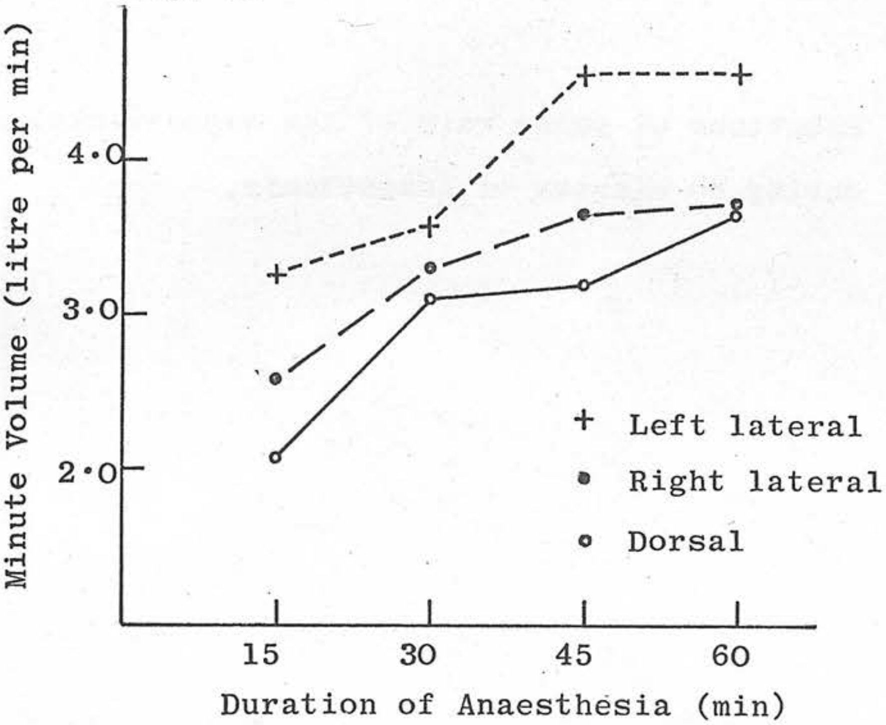
Placed in sequence, for comparison, above Fig. 84.

Fig. 87



Minute Volume (litre per min)
4·0
3·0
2·0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 88



Minute Volume (litre per min)
4·0
3·0
2·0
+ Left lateral
• Right lateral
○ Dorsal
15
30
45
60
Duration of Anaesthesia (min)

Fig. 91

Comparison of the behaviour of pulse rate of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 90

Behaviour of pulse rate of the experimental dogs during 60 minutes of anaesthesia.

Fig. 91

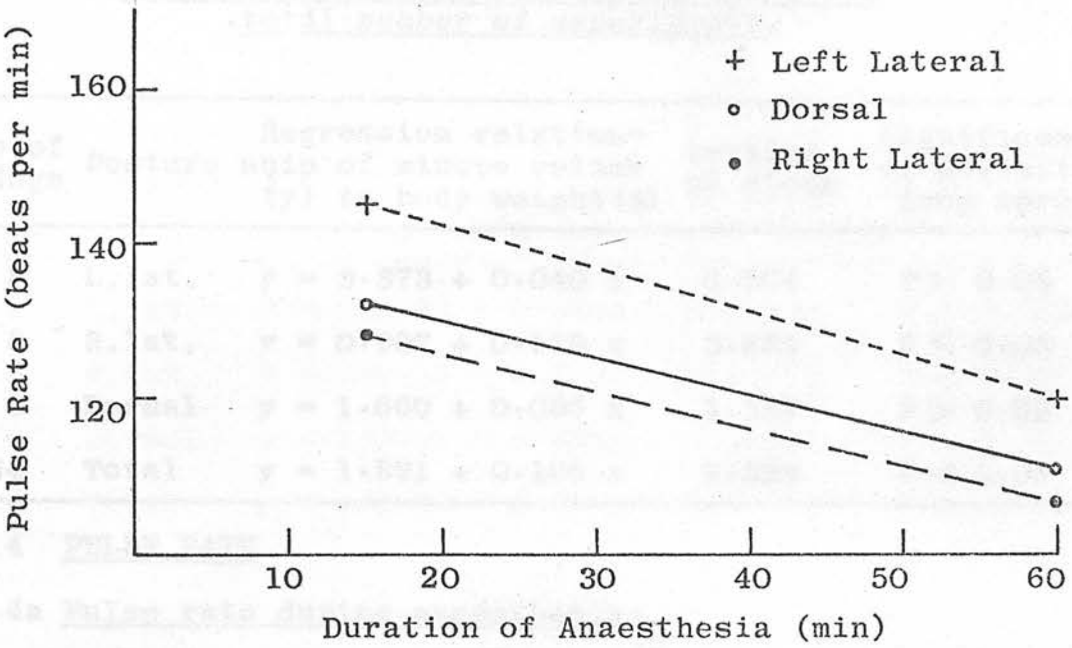

+ Left Lateral
o Dorsal
• Right Lateral
Pulse Rate (beats per min)
160
140
120
10
20
30
40
50
60
Duration of Anaesthesia (min)

Fig. 90

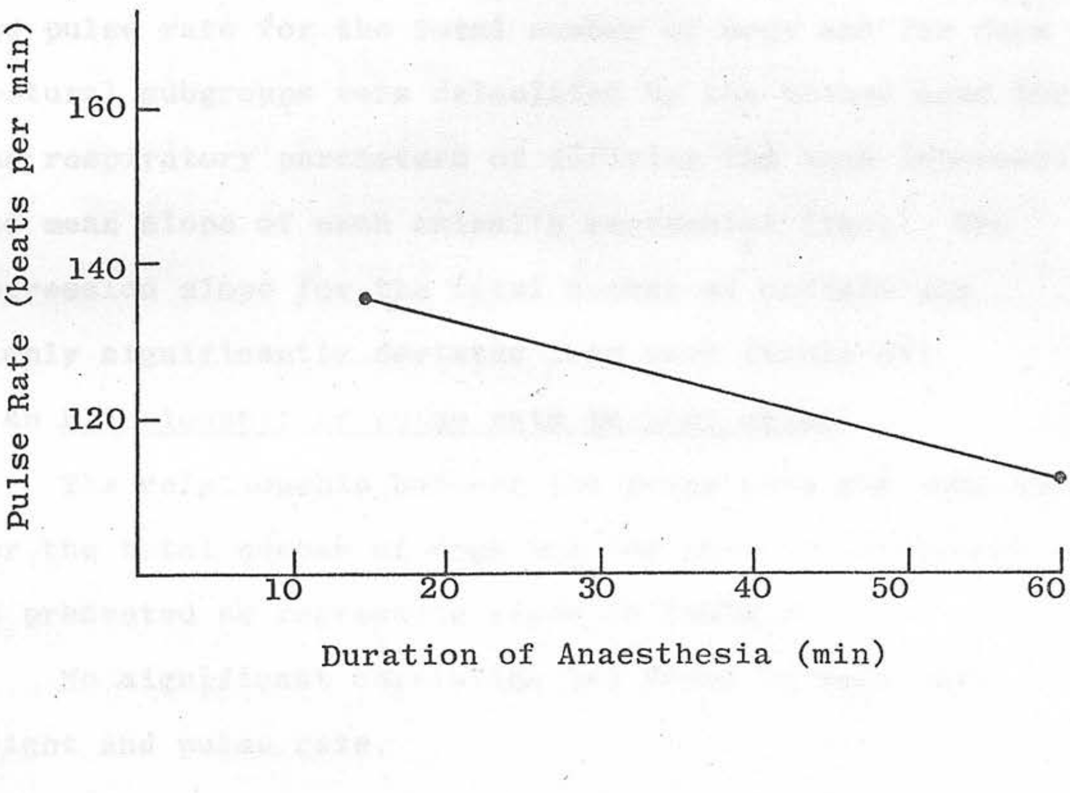

Pulse Rate (beats per min)
160
140
120
10
20
30
40
50
60
Duration of Anaesthesia (min)

Table 36

Relationship of minute volume (litres) to body weight (kg) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No. of dogs	Posture	Regression relationship of minute volume (y) to body weight (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 3.373 + 0.040\ x$	0.364	$P > 0.05$
8	R.lat.	$y = 0.907 + 0.179\ x$	3.255	$P < 0.05$
8	Dorsal	$y = 1.660 + 0.096\ x$	1.352	$P > 0.05$
24	Total	$y = 1.991 + 0.105\ x$	2.333	$P < 0.05$

7.4 PULSE RATE

7.4a Pulse rate during anaesthesia:

The effect on pulse rate of the duration of anaesthesia is shown in figure 90. Pulse rate was found to fall progressively throughout the 60 minutes of anaesthesia. The regression relationships of the duration of anaesthesia and pulse rate for the total number of dogs and for dogs in postural subgroups were calculated by the method used for the respiratory parameters of deriving the mean intercept and mean slope of each animal's regression line. The regression slope for the total number of animals was highly significantly deviated from zero (table 37).

7.4b Relationship of pulse rate to body weight:

The relationship between the pulse rate and body weight for the total number of dogs and for postural subgroups is presented as regression lines in table 38.

No significant corelation was found between body weight and pulse rate.

Table 37

Relationship of pulse rate (beats per min) to duration of anaesthesia (mins) for dogs in different postures and for the total number of experiments.

No. of dogs	Posture	Regression relationship of pulse rate (y) and duration of anaesthesia (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 153{\cdot}62 - 0{\cdot}564x$	$- 6{\cdot}483$	$P < 0{\cdot}001$
8	R.lat.	$y = 136{\cdot}12 - 0{\cdot}502x$	$-11{\cdot}674$	$P < 0{\cdot}001$
8	Dorsal	$y = 139{\cdot}81 - 0{\cdot}492x$	$- 4{\cdot}205$	$P < 0{\cdot}01$
24	Total	$y = 143{\cdot}21 - 0{\cdot}519x$	$-10{\cdot}592$	$P < 0{\cdot}001$

Table 38

Relationship of pulse rate (beats per min) to body weight (kg) for dogs in different postures and for the total number of experiments.

No. of dogs	Posture	Regression relationship of pulse rate (y) to body weight (x)	t-value of slope	Significance of deviation from zero
8	L.lat.	$y = 156{\cdot}892 - 2{\cdot}565\ x$	$-0{\cdot}623$	$P > 0{\cdot}05$
8	R.lat.	$y = 101{\cdot}782 - 1{\cdot}994\ x$	$0{\cdot}585$	$P > 0{\cdot}05$
8	Dorsal	$y = 135{\cdot}378 - 0{\cdot}687\ x$	$-0{\cdot}177$	$P > 0{\cdot}05$
24	Total	$y = 131{\cdot}427 - 0{\cdot}419\ x$	$-0{\cdot}210$	$P > 0{\cdot}05$

7.4c Effect of posture on pulse rate:

The behaviour of the pulse rate in each of the groups maintained in differing postures is indicated in figures 92 to 95, and the regression relationship of the postural relationship is shown in figure 91. The relationship of duration of anaesthesia to pulse rate was significant for left lateral posture.

Fig. 92

Mean (± standard error) values of pulse rate of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 93

Mean (± standard error) values of pulse rate of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 92

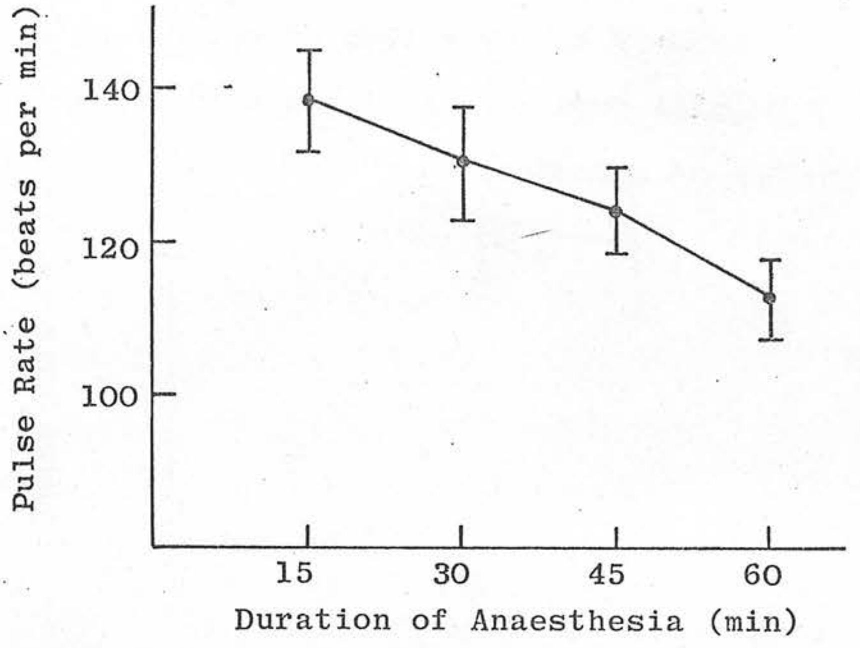

Pulse Rate (beats per min)
140
120
100
15
30
45
60
Duration of Anaesthesia (min)

Fig. 93

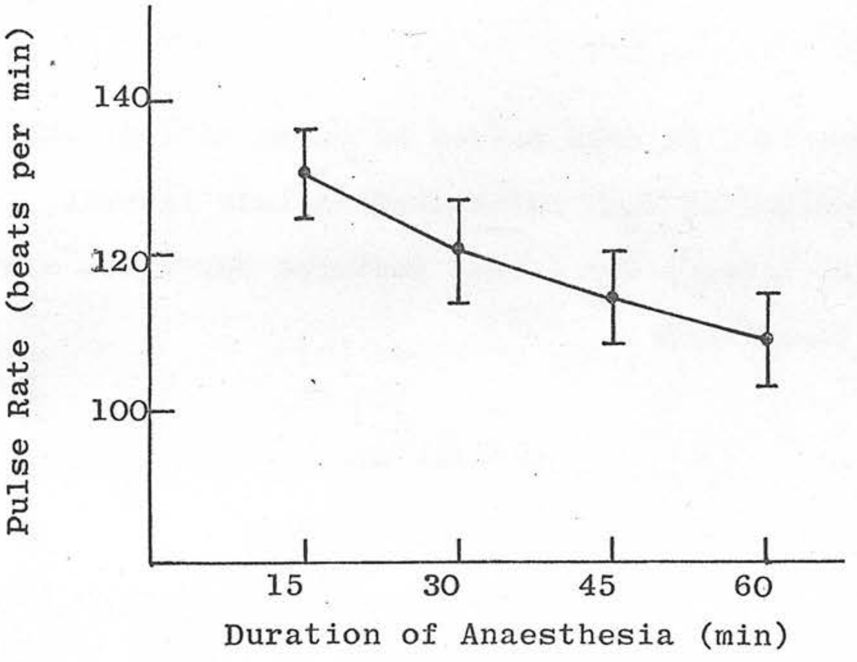

Pulse Rate (beats per min)
140
120
100
15
30
45
60
Duration of Anaesthesia (min)

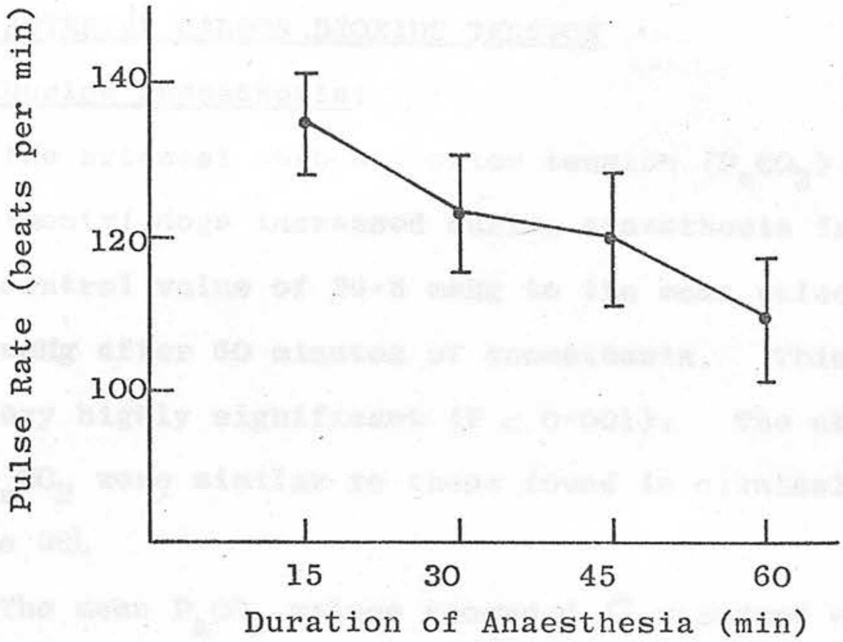
Fig. 94

Mean ($\pm$ standard error) values of pulse rate of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 95

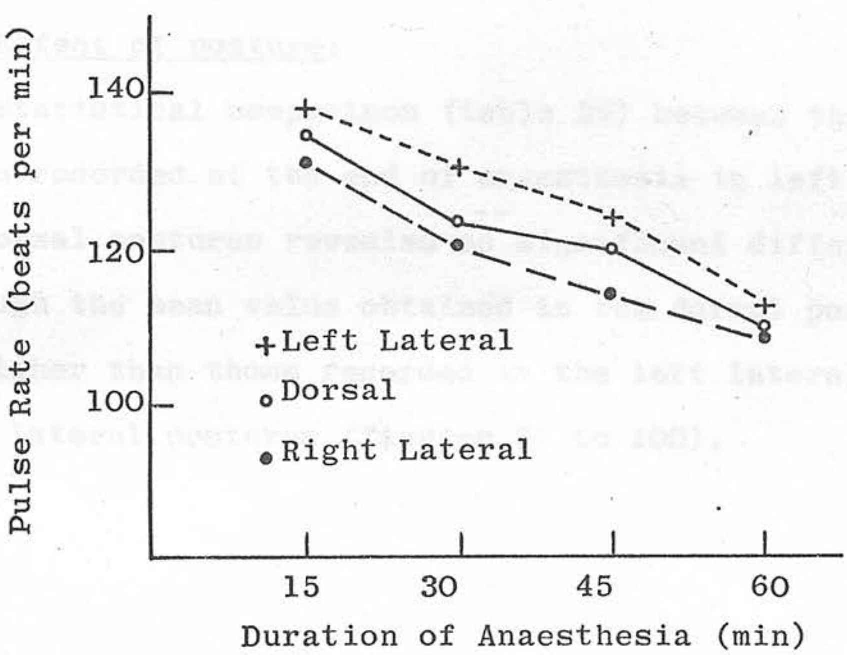
Comparison of mean values of pulse rate of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 94



Pulse Rate (beats per min)
140
120
100
15
30
45
60
Duration of Anaesthesia (min)

Fig. 95



Pulse Rate (beats per min)
140
120
100
+ Left Lateral
o Dorsal
• Right Lateral
15
30
45
60
Duration of Anaesthesia (min)

8.0 BIOCHEMICAL PARAMETERS

The biochemical data obtained from the experimental animals are shown in appendix VIII.

8.1 ARTERIAL CARBON DIOXIDE TENSION

8.1a During anaesthesia:

The arterial carbon dioxide tension (P_aCO_2) of all experimental dogs increased during anaesthesia from the mean control value of 36·8 mmHg to the mean value of 57·9 mmHg after 60 minutes of anaesthesia. This increase was very highly significant ($P < 0{\cdot}001$). The changes in the P_aCO_2 were similar to those found in clinical dogs, (figure 96).

The mean P_aCO_2 values recorded ($\pm$ standard error) and the significance of the change for the total number of experiments and for postural subgroups are indicated in table 39.

8.1b Effect of posture:

Statistical comparison (table 39) between the mean values recorded at the end of anaesthesia in left lateral and dorsal postures revealed no significant difference, although the mean value obtained in the dorsal position was higher than those recorded in the left lateral and right lateral postures (figures 97 to 100).

Fig. 96

Mean ($\pm$ standard error) values of carbon dioxide tension of the experimental dogs during 60 minutes of anaesthesia.

Fig. 101

Mean ($\pm$ standard error) values of pH of the experimental dogs during 60 minutes of anaesthesia.

Fig. 96

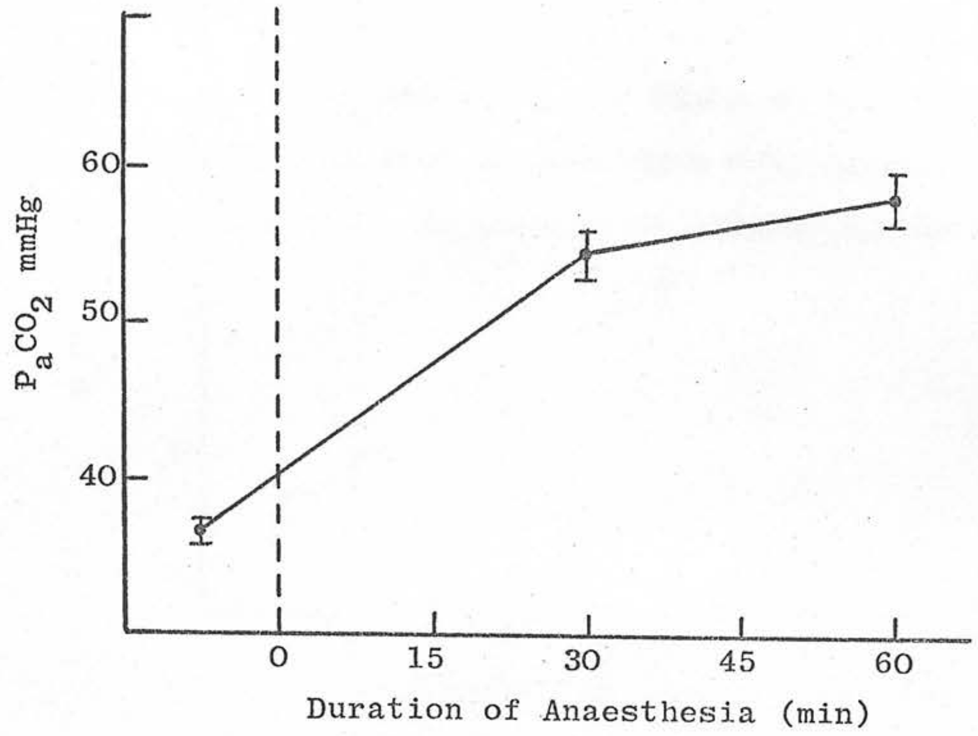


Fig. 101

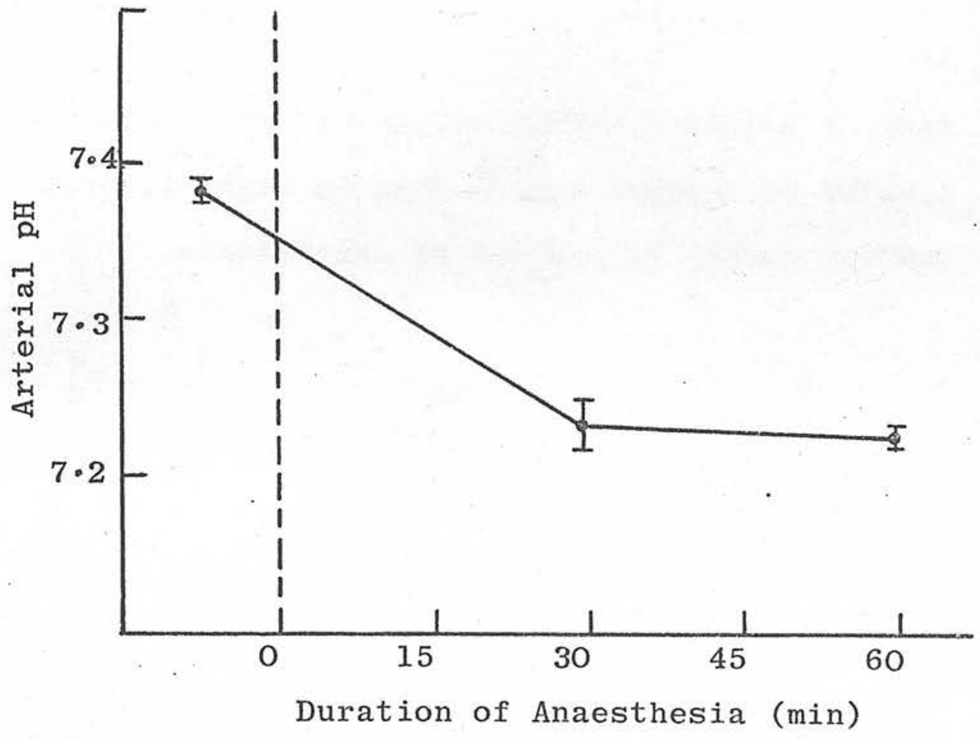


Fig. 97

Mean (± standard error) values of carbon dioxide tension of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 98

Mean (± standard error) values of carbon dioxide tension of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 97

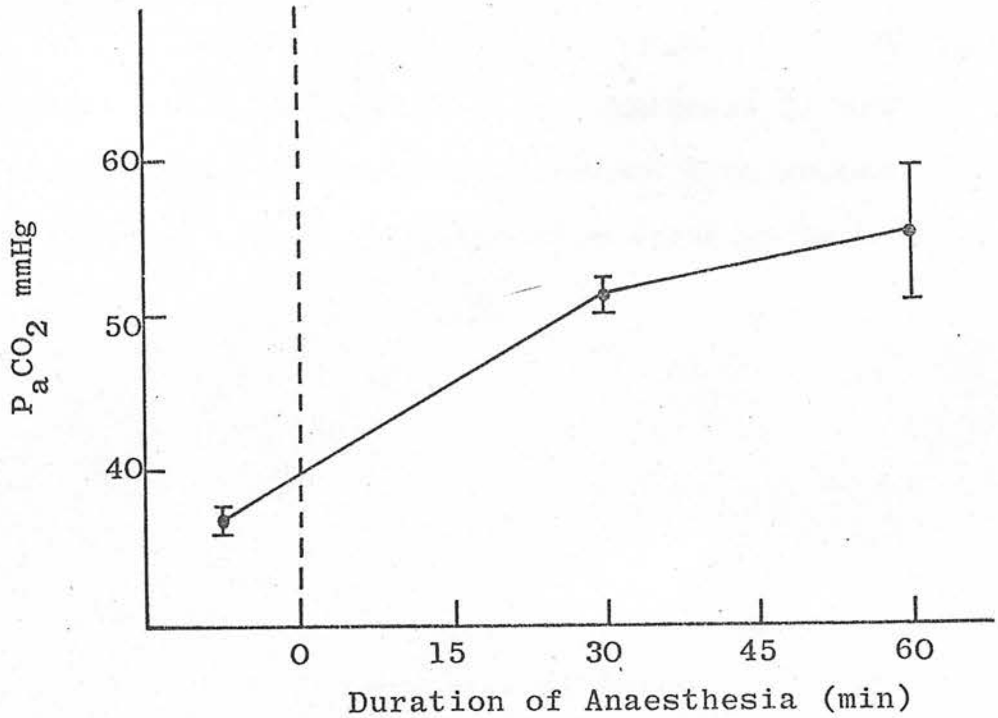

60
50
40
P_aCO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 98

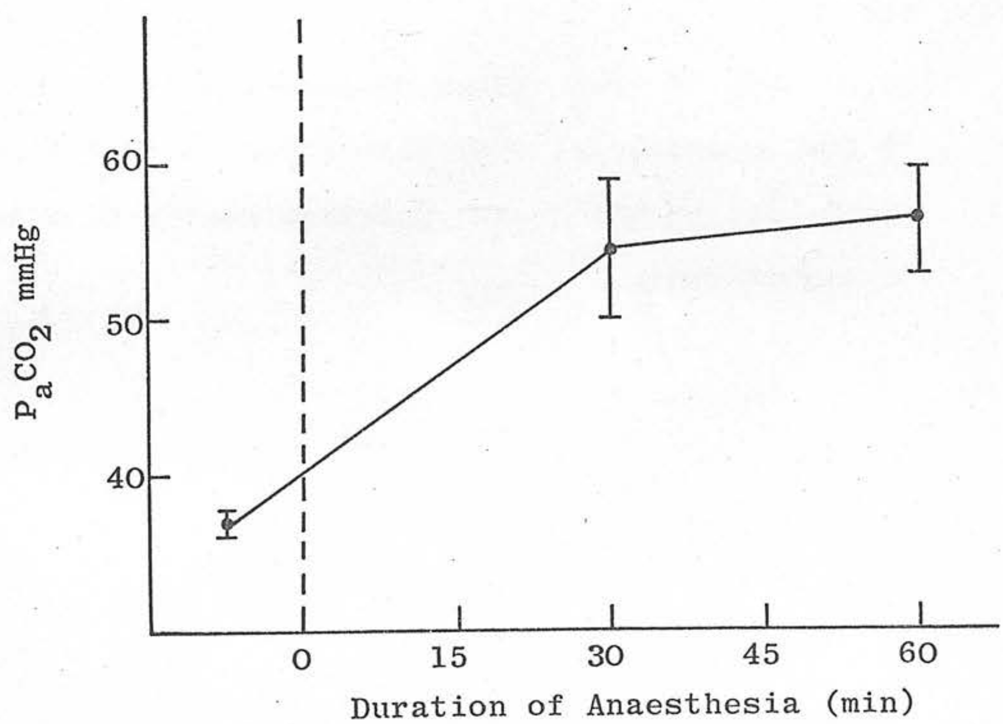

60
50
40
P_aCO_2 mmHg
0
15
30
45
60
Duration of Anaesthesia (min)

Fig. 99

Mean (± standard error) values of carbon dioxide tension of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 100

Comparison of mean values of carbon dioxide tension of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 99

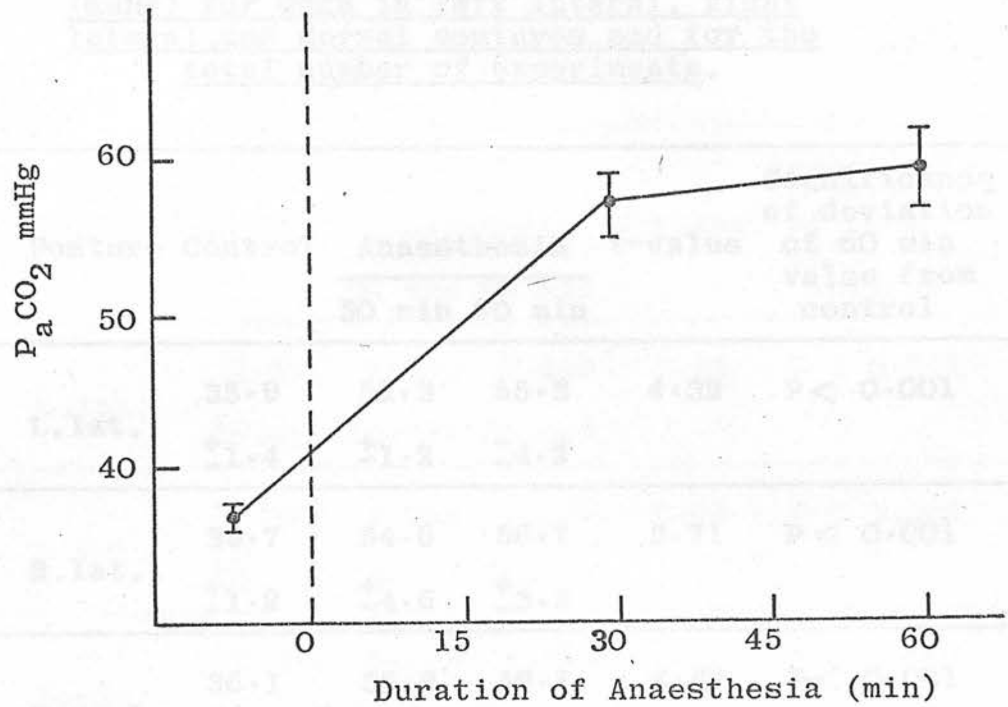


Fig.100

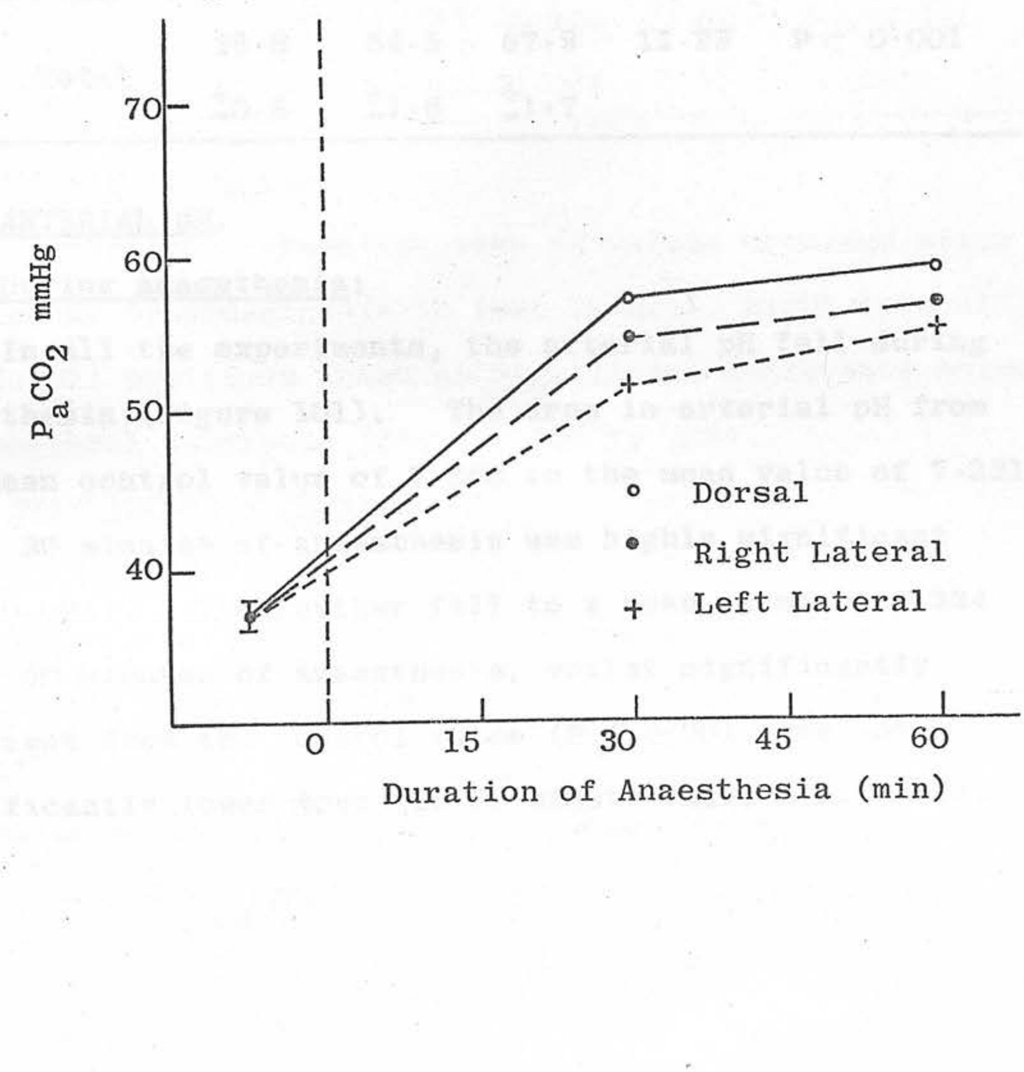


Table 39

Mean ($\pm$ standard error) values for P_aCO_2 (mmHg) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No. of dogs	Posture	Control	Anaesthesia 30 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control
8	L.lat.	35·9 $\pm$1·4	51·3 $\pm$1·2	55·3 $\pm$4·2	4·32	$P < 0{\cdot}001$
8	R.lat.	39·7 $\pm$1·2	54·6 $\pm$4·6	56·7 $\pm$3·5	5·71	$P < 0{\cdot}001$
8	Dorsal	36·1 $\pm$1·3	56·9 $\pm$2·2	59·1 $\pm$2·4	8·82	$P < 0{\cdot}001$
24	Total	36·8 $\pm$0·8	54·5 $\pm$1·6	57·9 $\pm$1·7	11·28	$P < 0{\cdot}001$

8.2 ARTERIAL pH.

8.2a During anaesthesia:

In all the experiments, the arterial pH fell during anaesthesia (figure 101). The drop in arterial pH from the mean control value of 7·380 to the mean value of 7·231 after 30 minutes of anaesthesia was highly significant ($P < 0{\cdot}001$). The further fall to a mean value of 7·224 after 60 minutes of anaesthesia, whilst significantly different from the control value ($P < 0{\cdot}001$) was not significantly lower than the 30 minute value (table 40).

Table 40

Mean (± standard error) values for pH for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No.of dogs	Posture	Control	Anaesthesia		t-value	Significance of deviation of 60 min value from control
			30 min	60 min		
8	L.lat.	7·371 ±0·016	7·260 ±0·011	7·238 ±0·029	7·95	$P < 0{\cdot}001$
8	R.lat.	7·398 ±0·014	7·265 ±0·014	7·239 ±0·019	6·12	$P < 0{\cdot}001$
8	Dorsal	7·373 ±0·012	7·238 ±0·012	7·221 ±0·014	8·10	$P < 0{\cdot}001$
24	Total	7·380 ±0·003	7·231 ±0·015	7·224 ±0·003	11·20	$P < 0{\cdot}001$

8.2b Effect of posture:

Comparison between the mean pH values obtained after 60 minutes of anaesthesia in left lateral, right lateral and dorsal positions shown no significant difference between the postural subgroups (figures 102 to 105).

8.3 STANDARD BICARBONATE

8.3a During anaesthesia:

The mean standard bicarbonate values recorded (± standard error of the means) with their t-values are indicated in table 41. The behaviour of the standard bicarbonate over the duration of anaesthesia is illustrated in figure 106. There was a tendency for the standard

Fig. 101

Placed in sequence, for comparison, below Fig. 96.

Fig. 102

Mean (± standard error) values of arterial pH of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 103

Mean (± standard error) values of arterial pH of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 102

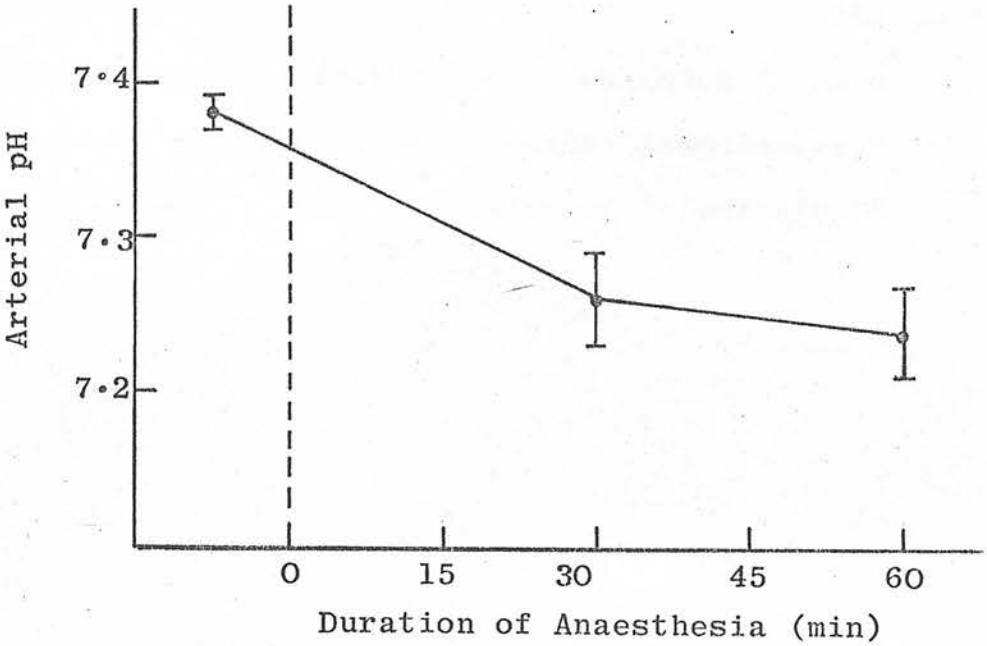


Fig. 103

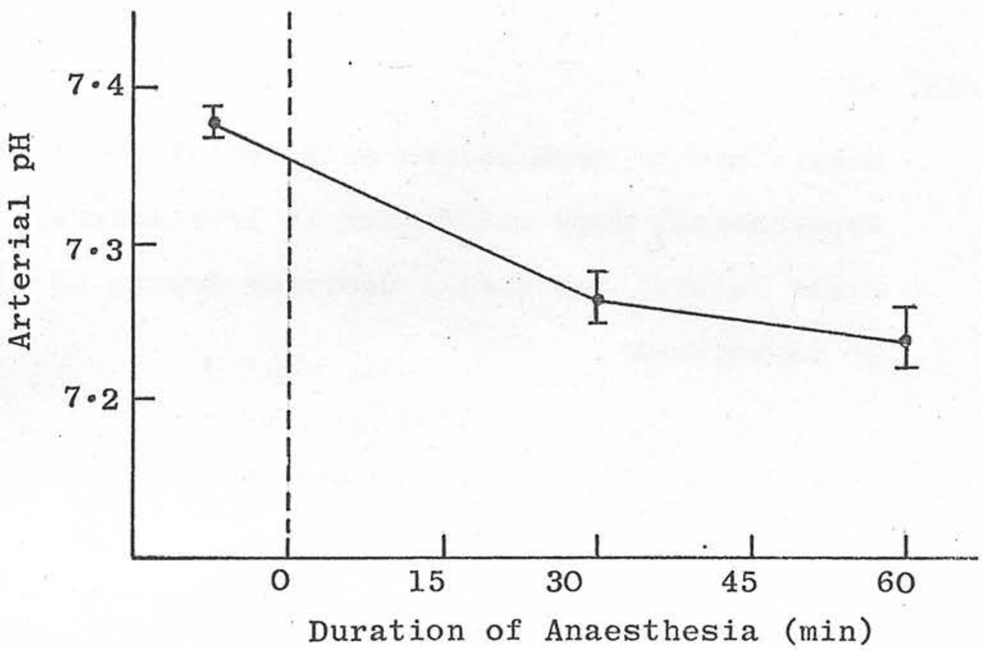


Fig. 104

Mean ($\pm$ standard error) values of arterial pH of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 105

Comparison of mean values of arterial pH of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 104

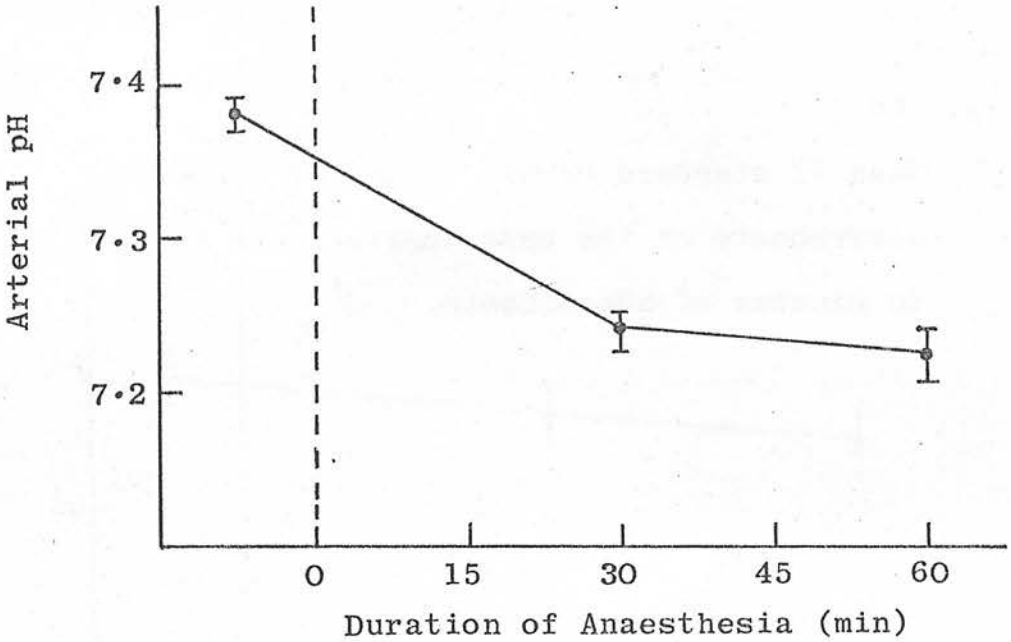


Fig. 105

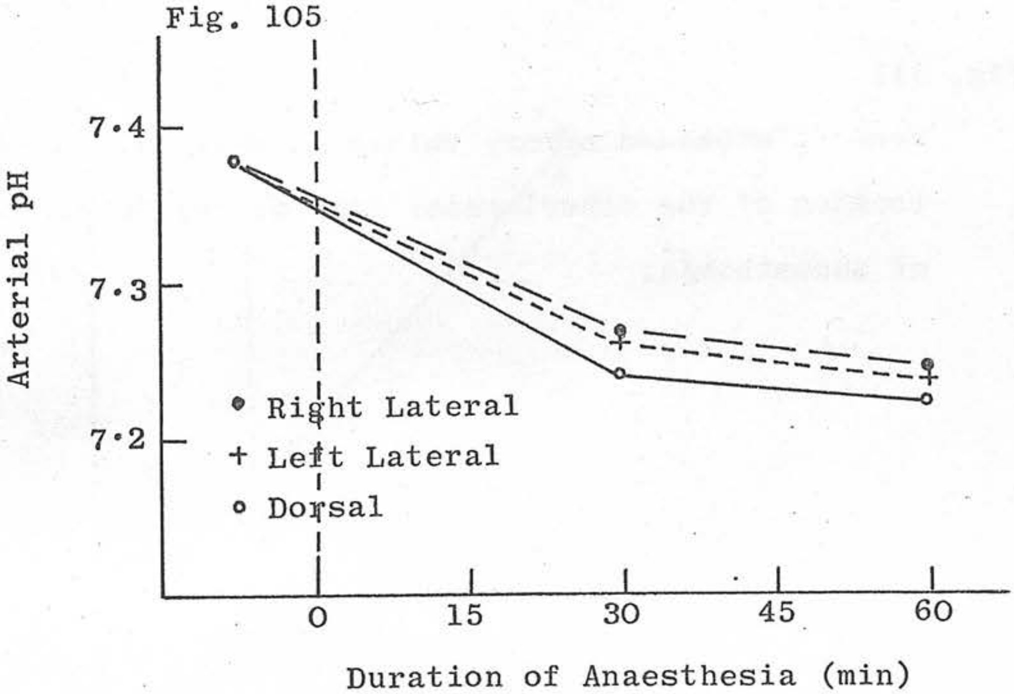


Fig. 106

Mean (± standard error) values of standard bicarbonate of the experimental dogs during 60 minutes of anaesthesia.

Fig. 111

Mean (± standard error) values of arterial oxygen tension of the experimental dogs during 60 minutes of anaesthesia.

Fig. 106

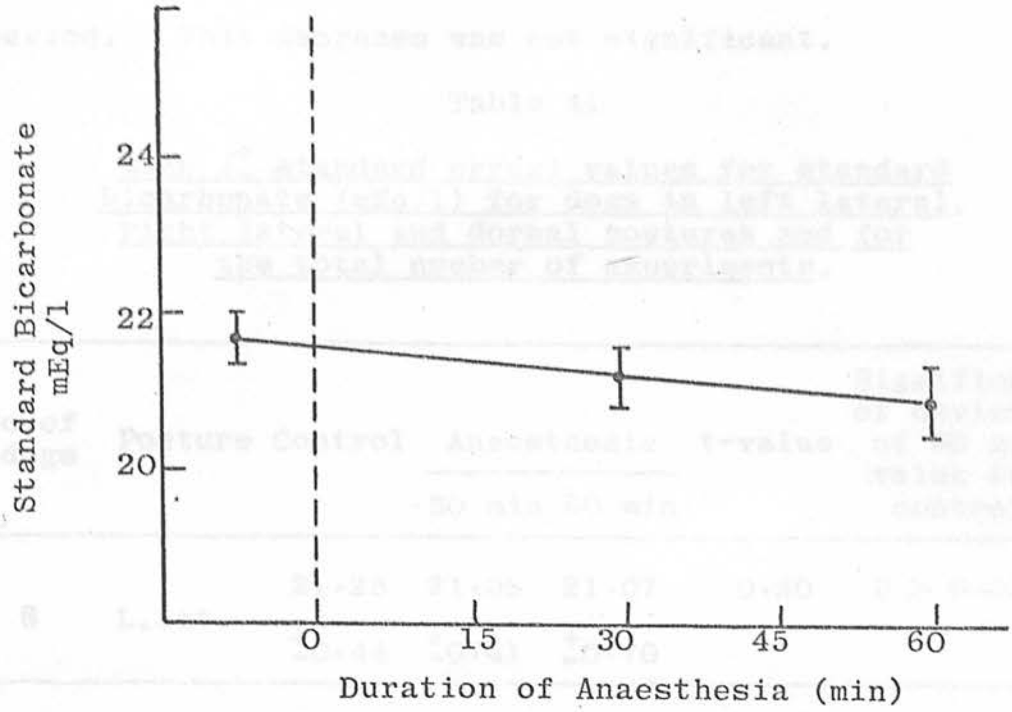
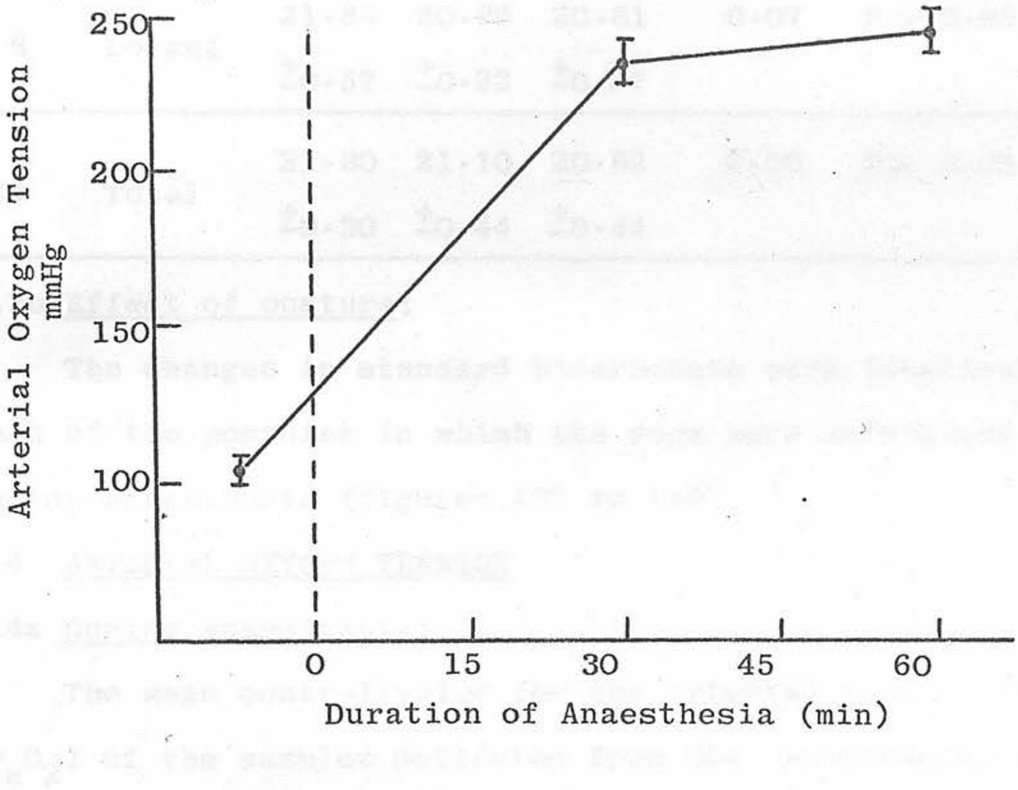


Fig. 111



bicarbonate to fall during anaesthesia from the mean control value of 21·80 mEq per litre to a mean value of 20·82 mEq per litre at the end of the anaesthetic period. This decrease was not significant.

Table 41

Mean (± standard error) values for standard bicarbonate (mEq/l) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No.of dogs	Posture	Control	Anaesthesia 30 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control
8	L.lat.	21·25 ±0·44	21·05 ±0·41	21·07 ±0·70	0·20	$P > 0.05$
8	R.lat.	22·25 ±0·46	21·28 ±1·15	20·59 ±0·93	1·50	$P > 0.05$
8	Dorsal	21·86 ±0·57	20·96 ±0·22	20·81 ±0·27	0·07	$P > 0.05$
24	Total	21·80 ±0·30	21·10 ±0·44	20·82 ±0·44	2·00	$P > 0.05$

8.3b Effect of posture:

The changes in standard bicarbonate were identical in each of the postures in which the dogs were maintained during anaesthesia (figures 107 to 110).

8.4 ARTERIAL OXYGEN TENSION

8.4a During anaesthesia:

The mean control value for the arterial oxygen tension (P_aO_2) of the samples collected from the experimental dogs which were breathing air was 105·4 mmHg. The mean values

Fig. 107

Mean ($\pm$ standard error) values of standard bicarbonate of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 108

Mean ($\pm$ standard error) values of standard bicarbonate of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 107

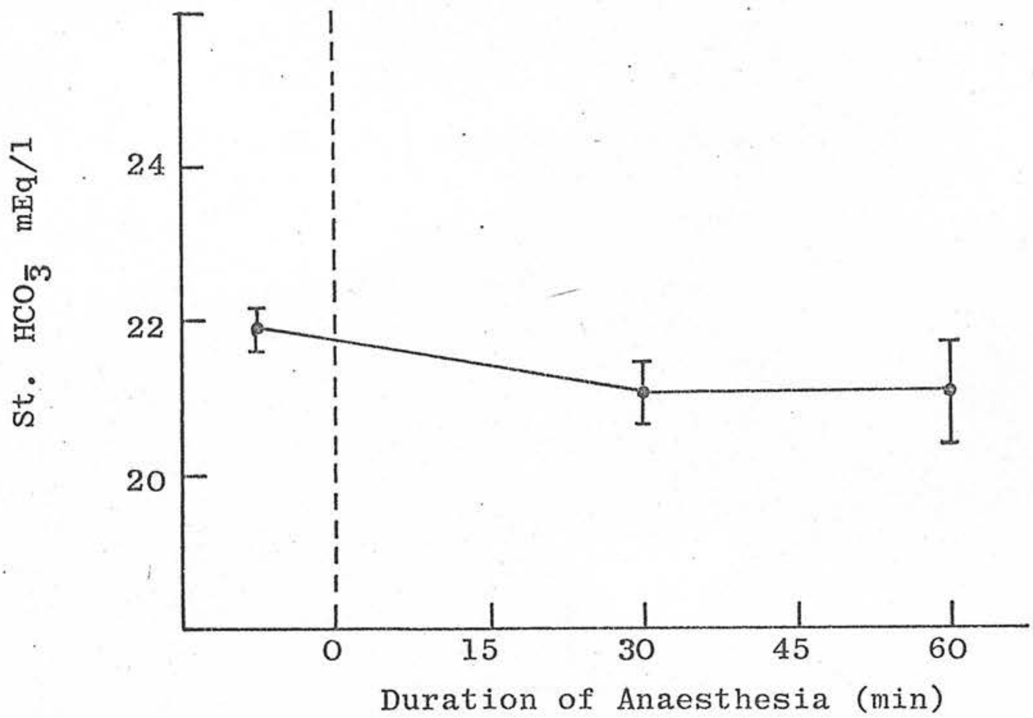


Fig. 108

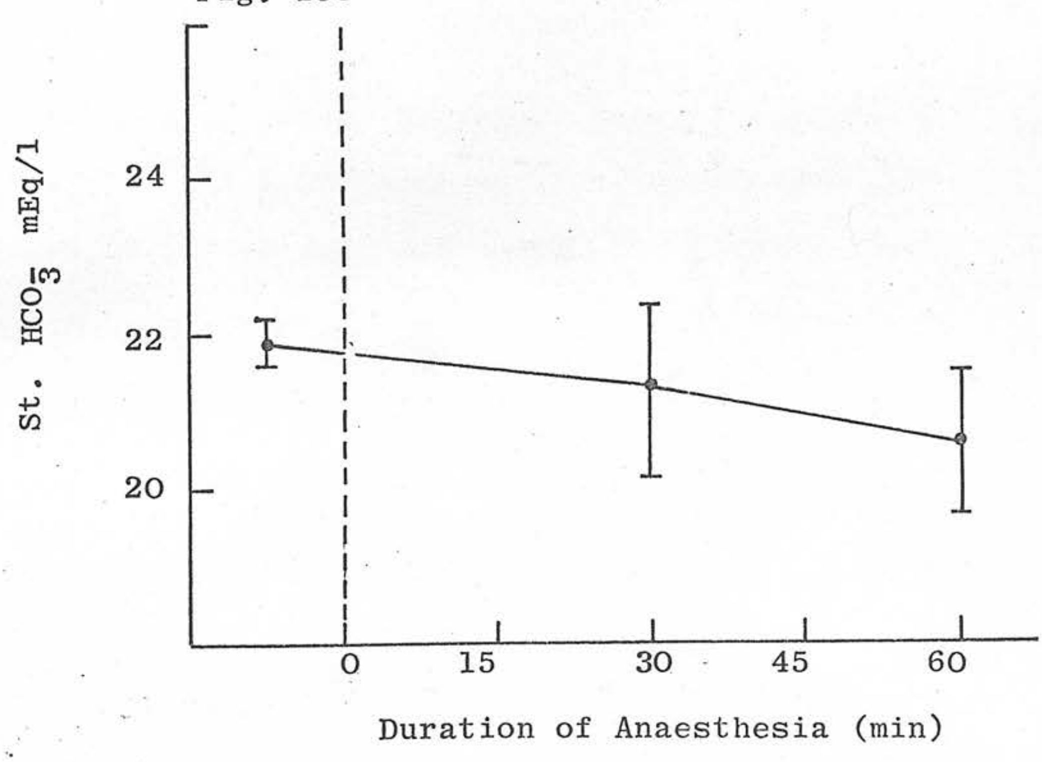


Fig. 109

Mean ($\pm$ standard error) values of standard bicarbonate of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 110

Comparison of mean values of standard bicarbonate of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 111

Placed in sequence, for comparison, below Fig. 106.

Fig. 109

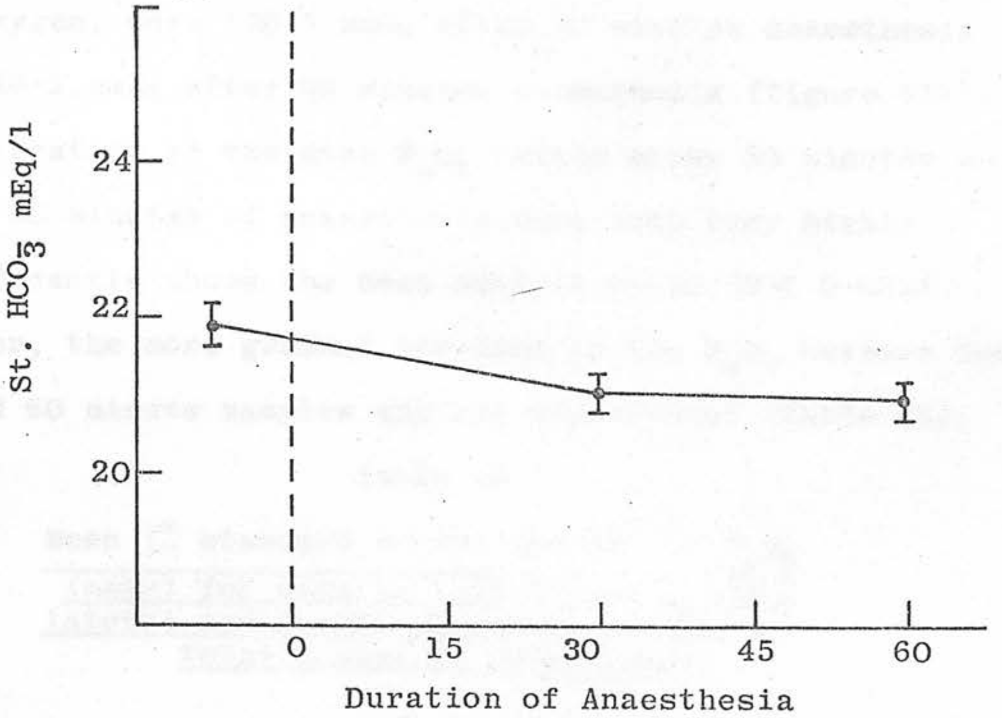
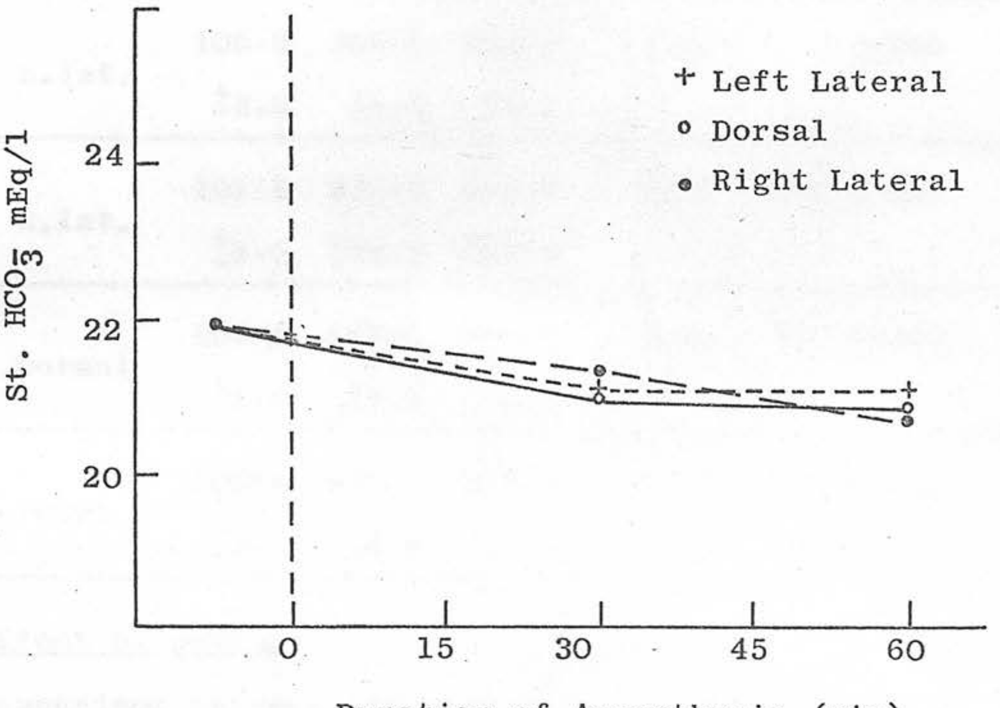


Fig. 110



for P_aO_2 of samples collected during anaesthesia, when the dogs were breathing an inspired mixture containing 50% oxygen, were 230·5 mmHg after 30 minutes anaesthesia and 246·2 mmHg after 60 minutes anaesthesia (figure 111). The elevation of the mean P_aO_2 values after 30 minutes and after 60 minutes of anaesthesia were both very highly significantly above the mean control value ($P < 0{\cdot}001$). However, the more gradual increase in the P_aO_2 between the 30 and 60 minute samples was not significant (table 42).

Table 42

Mean (± standard error) values for P_aO_2 (mmHg) for dogs in left lateral, right lateral and dorsal postures and for the total number of experiments.

No. of dogs	Posture	Control	Anaesthesia 30 min	Anaesthesia 60 min	t-value	Significance of deviation of 60 min value from control
8	L.lat.	105·8 ±8·6	228·6 ±6·4	243·7 ±5·7	17·61	$P < 0{\cdot}001$
8	R.lat.	101·9 ±2·0	235·0 ±13·3	253·8 ±15·5	8·79	$P < 0{\cdot}001$
8	Dorsal	109·4 ±2·0	217·6 ±7·3	241·1 ±4·4	9·50	$P < 0{\cdot}001$
24	Total	105·4 ±3·0	230·5 ±6·4	246·2 ±5·4	20·66	$P < 0{\cdot}001$

8.4b Effect of posture:

Comparison between the mean P_aO_2 values obtained at the end of anaesthesia in left lateral, right lateral and

Fig. 112

Mean (± standard error) values of arterial oxygen tension of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 113

Mean (± standard error) values of arterial oxygen tension of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 112

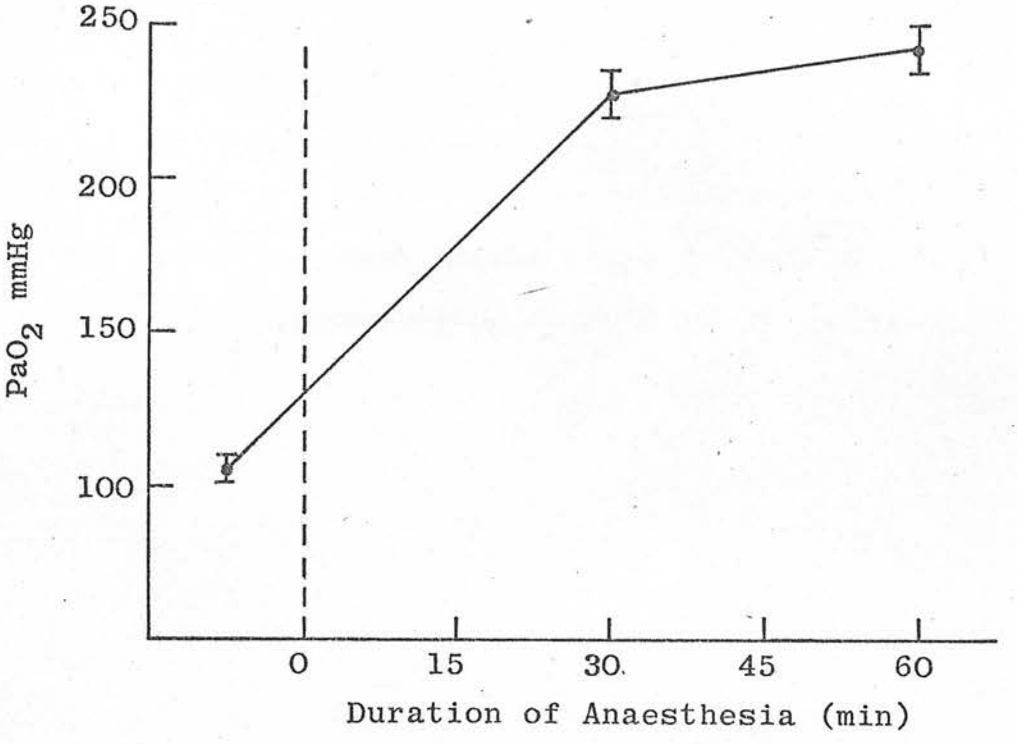


Fig. 113

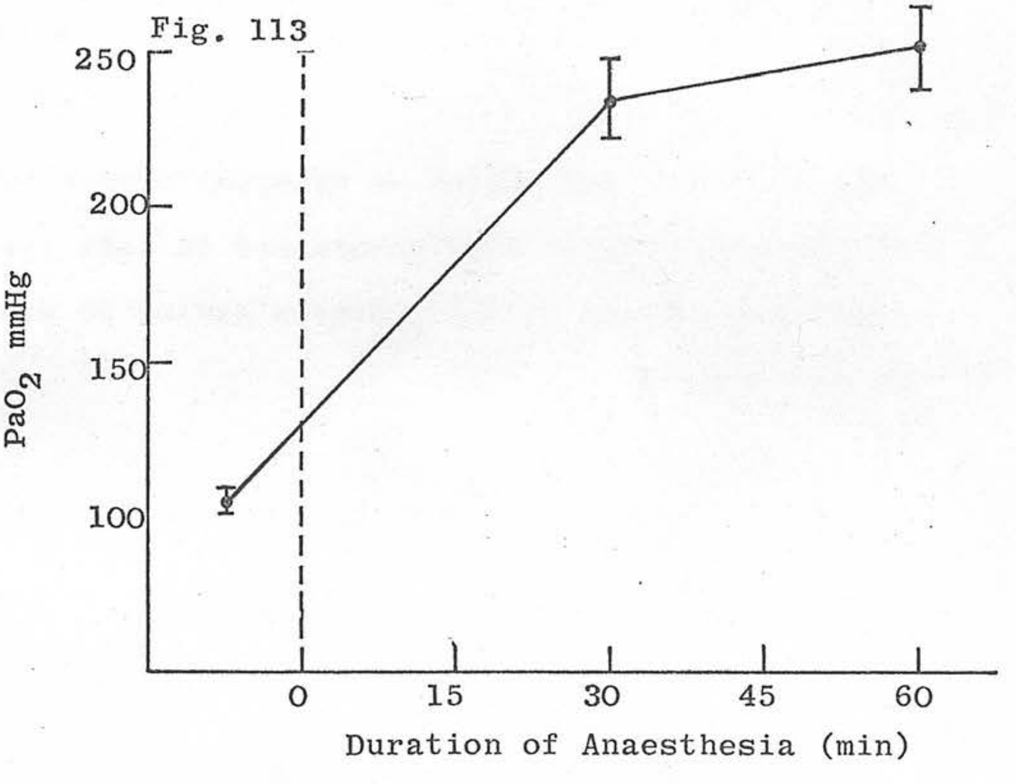


Fig. 114

Mean ($\pm$ standard error) values of arterial oxygen tension of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 115

Comparison of mean values of arterial oxygen tension of the experimental dogs maintained in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 114

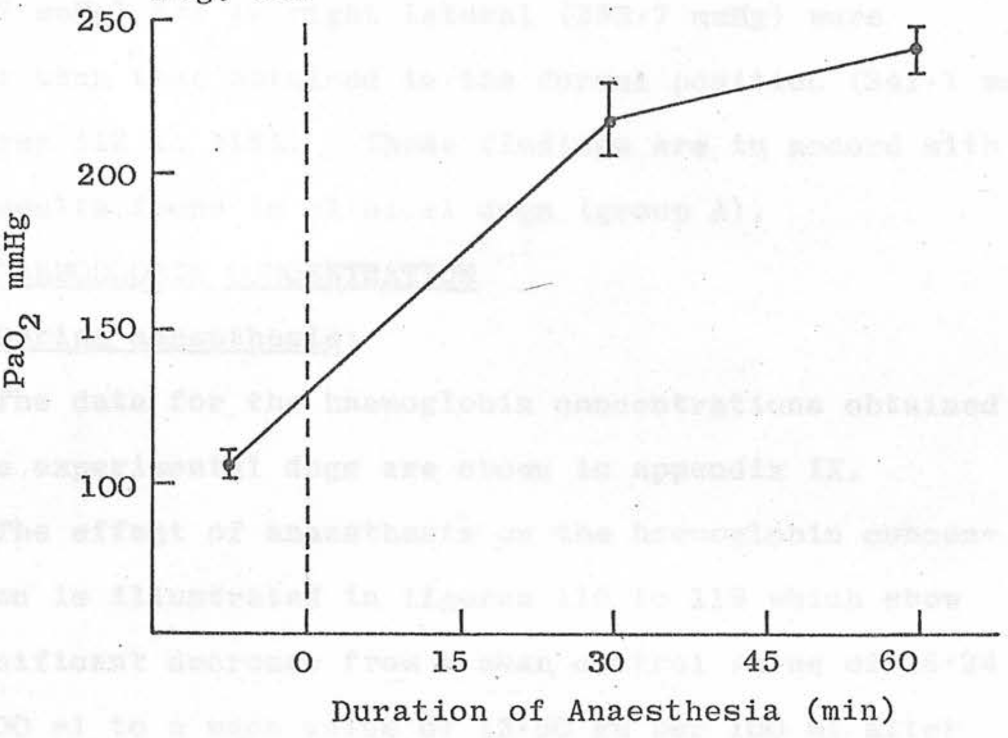
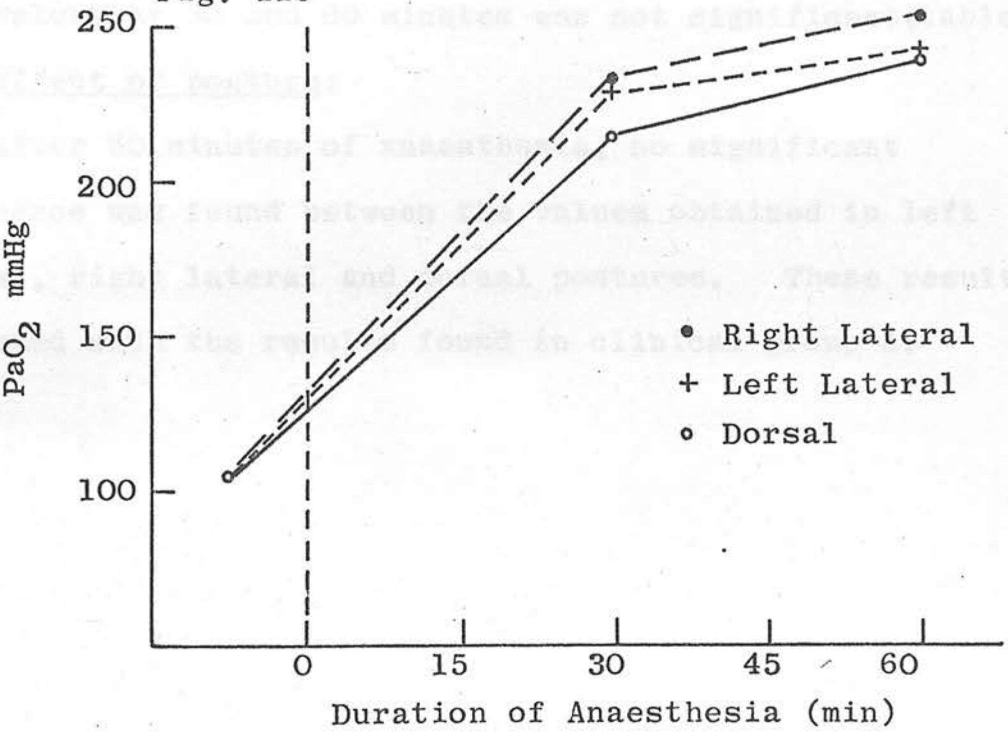


Fig. 115



dorsal positions revealed no demonstrable difference, although the mean P_aO_2 values recorded in left lateral (243·7 mmHg) and in right lateral (253·7 mmHg) were higher than that obtained in the dorsal position (241·1 mmHg) (figures 112 to 115). These findings are in accord with the results found in clinical dogs (group A).

8.5 <u>HAEMOGLOBIN CONCENTRATION</u>

8.5a <u>During anaesthesia</u>:

The data for the haemoglobin concentrations obtained in the experimental dogs are shown in appendix IX.

The effect of anaesthesia on the haemoglobin concentration is illustrated in figures 116 to 119 which show a significant decrease from a mean control value of 16·24 gm per 100 ml to a mean value of 13·60 gm per 100 ml after 60 minutes of anaesthesia. The difference between the mean values at 30 and 60 minutes was not significant (table 43).

8.5b <u>Effect of posture</u>:

After 60 minutes of anaesthesia, no significant difference was found between the values obtained in left lateral, right lateral and dorsal postures. These results conformed with the results found in clinical group A.

Fig. 116

Mean (± standard error) values of haemoglobin concentration of 8 experimental dogs in left lateral posture during 60 minutes of anaesthesia.

Fig. 117

Mean (± standard error) values of haemoglobin concentration of 8 experimental dogs in right lateral posture during 60 minutes of anaesthesia.

Fig. 116

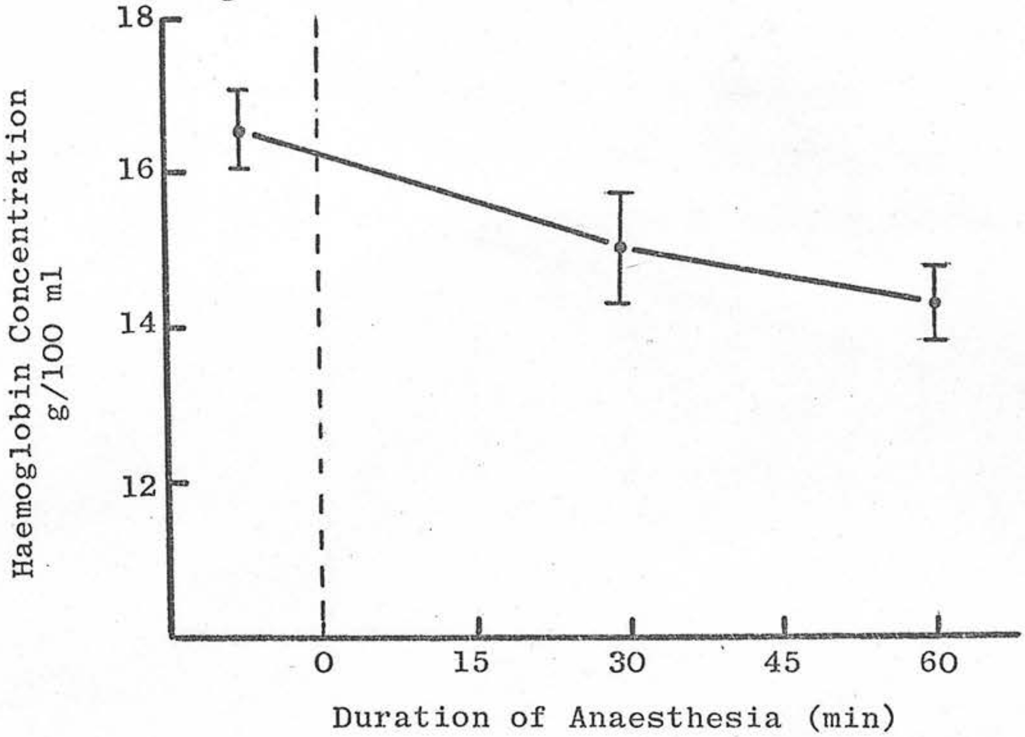


Fig. 117

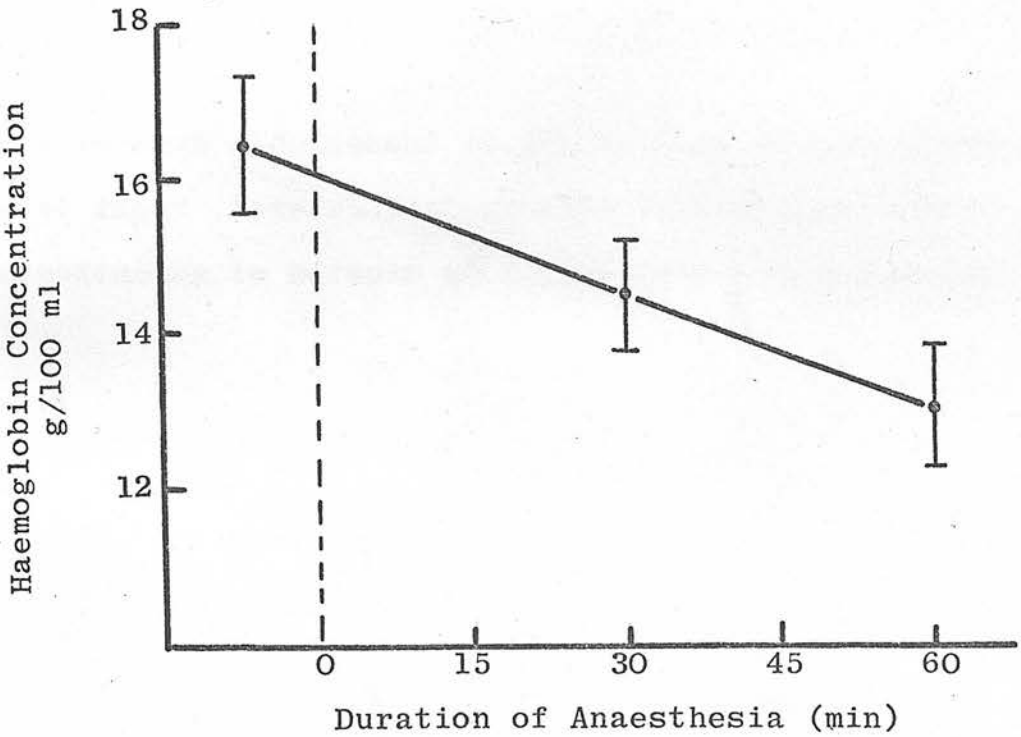


Fig. 118

Mean ($\pm$ standard error) values of haemoglobin concentration of 8 experimental dogs in dorsal posture during 60 minutes of anaesthesia.

Fig. 119

Comparison of mean values of haemoglobin concentration of the experimental dogs in left lateral, right lateral and dorsal postures during 60 minutes of anaesthesia.

Fig. 118

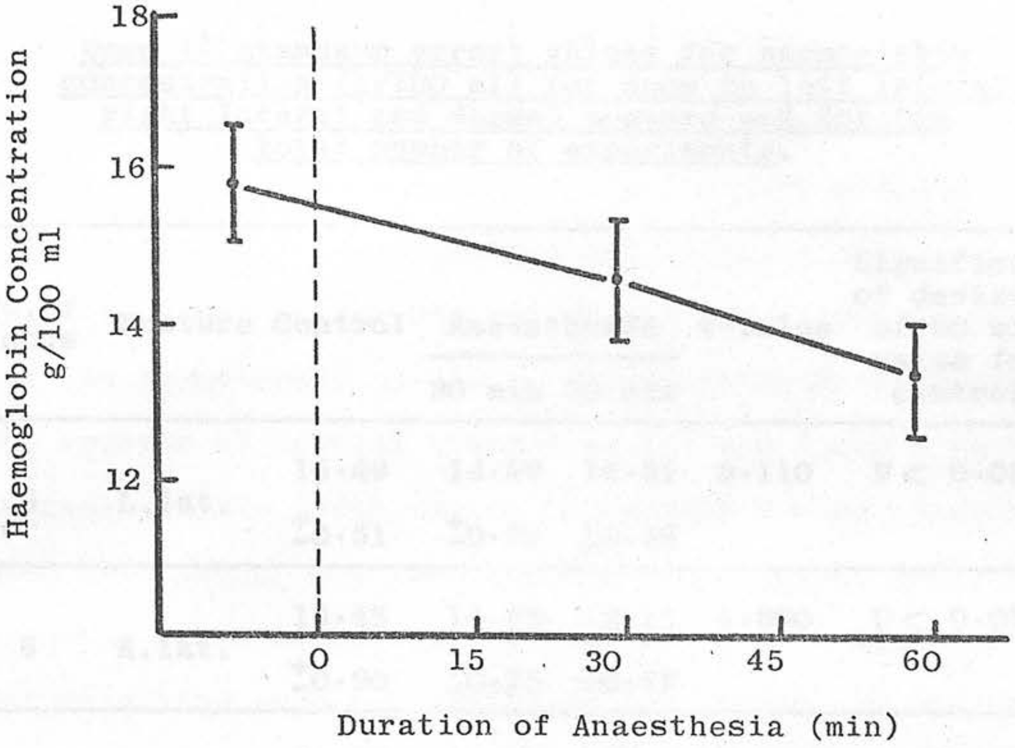


Fig. 119

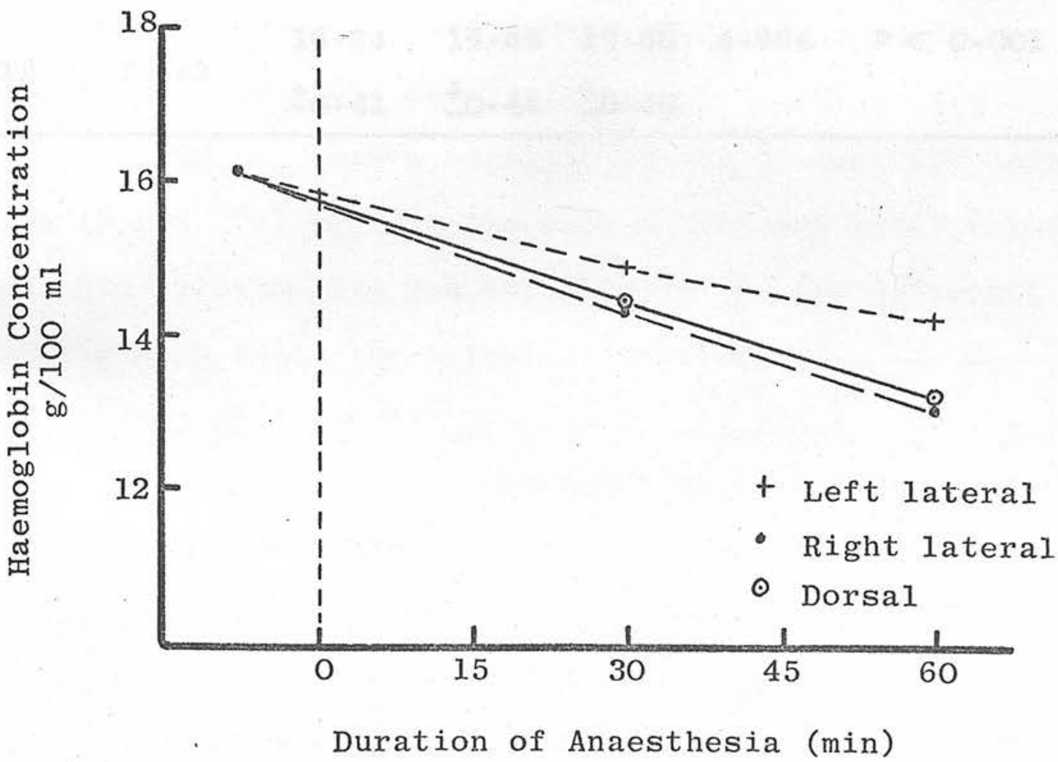


Table 43

Mean (± standard error) values for haemoglobin concentration (g/100 ml) for dogs in left lateral, right lateral and dorsal posture and for the total number of experiments.

No. of dogs	Posture	Control	Anaesthesia		t-value	Significance of deviation of 60 min value from control
			30 min	60 min		
6	L.lat.	16·49 ±0·51	14·99 ±0·76	14·31 ±0·48	3·110	P < 0·05
6	R.lat.	16·45 ±0·90	14·53 ±0·75	13·11 ±0·79	2·800	P < 0·05
6	Dorsal	15·82 ±0·80	14·57 ±0·89	13·37 ±0·76	2·228	P < 0·05
18	Total	16·24 ±0·41	14·68 ±0·44	13·60 ±0·40	4·664	P < 0·001

DISCUSSION.

9.0 PHYSIOLOGICAL PARAMETERS

9.1 TIDAL VOLUME

9.1a During Anaesthesia:

In the current research with the method of anaesthesia used namely, thiopentone sodium followed by nitrous oxide and halothane, both in group A and in the experimental dogs the tidal volume did not change significantly throughout the anaesthetic period. This finding differs from the reports of several authors (1.1b) who found a marked decrease in the tidal volume of animals during anaesthesia with halothane. In group B, the tidal volume fell, the probable cause being that in this group most of the tidal volume values were not available for the 40, 50 and 60 minute periods; also because the values recorded at the earlier stage of anaesthesia may have been lowered by the residual influence of thiopentone.

9.1b Tidal volume and body weight:

The results show a highly significant positive corelation ($P < 0 \cdot 001$) between the body weight and tidal volume and this relationship was not affected by the different positions in which the animals were placed.

9.1c Effect of posture:

The results of this investigation show that the tidal volume of anaesthetised dogs was not substantially influenced by different body positions. No previous work was found on the effect of different body positions on the tidal volume in dogs during anaesthesia, however, the results of this investigation accord with the finding of

Svanberg (1957), in unanaesthetised man, who found no difference in the tidal volume between lateral and dorsal positions.

9.2 RESPIRATORY RATE

9.2a During anaesthesia:

In this study the consistent, significant and progressive increase in the respiratory rate of the clinical dogs during anaesthesia differs from the results of Raventos (1956), Hall (1957), Hall and Norris (1958), Singleton (1960), Dobkin and Fedoruk (1961) and Dobkin et al. (1961). The likely reason for this difference is that the decrease in the respiratory rate found by these authors may be attributed to their administration of premedicant drugs which have long lasting depressive effects on the respiratory centre; alternatively their results may be due to the administration of higher doses of thiopentone sodium used for induction.

In the experimental group of dogs there was a tendency for the respiratory rate to increase, but the extent of this increase was not significant. This is likely to be merely a consequence of the small number of dogs used in this experimental series being inadequate to demonstrate a significant change in a factor having a relatively large variation in individual dogs and between different dogs.

9.2b Respiratory rate and body weight:

Study of the relationship of body weight to the respiratory rate in the clinical patients revealed an inverse corelation, small dogs having a much faster respiratory rate than large dogs.

In the experimental group, the number and range in the size of the dogs was inadequate to demonstrate this relationship.

9.2c Respiratory rate and posture:

In the 100 clinical cases monitored the results of this investigation show a significant difference in the respiratory rate between the group placed in the dorsal position and those placed in lateral recumbency ($P < 0{\cdot}01$). The dorsally recumbent group had a mean respiratory rate of 33·8 while the mean respiratory rate of the lateral groups was 23·7. The mean body weights of the two groups, dorsal and lateral, were closely comparable, being 21·54 kg and 20·08 kg respectively. In experimental dogs, however, the mean respiratory rate in all postures was found to be much lower than in the clinical cases. This change may be due to the fact that the experimental group were not subjected to surgical stimuli, whilst the clinical cases were continuously or intermittently subject to varying degrees of surgical trauma which by altering the balance of anaesthesia might stimulate respiration. This change in respiratory rate between lateral and dorsal recumbency differs from the reports of Svanberg (1957), in conscious human volunteers. Wood-Smith et al. (1960), found in human patients anaesthetised by halothane that differences in respiratory rate were randomly variable and not significantly related to changes of posture.

9.3 MINUTE VOLUME:

9.3a Minute volume during anaesthesia:

During anaesthesia the changes in the minute volume were a consequence of changes in either the respiratory

Because of the limits of accuracy of the Wright's respirometer when reading values of less than two litres per minute (under-reading) the minute volume values of the smallest dogs may be slightly higher than those indicated.

Nunn and Ezi-Ashi (1962) discussed the function of the Wright's respirometer in relation to clinical anaesthesia. During the intermittent flow of spontaneous respiration, the range of minute volume (MV) in which an accuracy to within ten per cent could be expected was between two litres per minute (under-reading) and twenty litres per minute (over-reading). During intermittent gas flow the accuracy of the instrument is influenced by the wave form and it was shown that the response of the respirometer is largely dependent upon peak flow rate (PFR). The relationship of PFR to MV will depend on the respiratory rate and on the character of respiratory movements. Slow respiratory rate, by increasing the tidal volume will lead to a high ratio of PFR:MV. Thus at low MV, when the instrument would be expected to under-read, the values of minute volume are more accurate in circumstances of reduction of respiratory rate. Gases having a density greater than air (air density 1, nitrous oxide 1·53) were shown to result in over-reading by the respirometer. At low minute volumes the accuracy of the respirometer would thus be improved but at high minute volumes, the inclusion of nitrous oxide would accentuate any over-reading error.

During anaesthesia the changes in the minute volume were a consequence of changes in either the respiratory rate or the tidal volume or of both. The results of this investigation show that the minute volume increased by about 56% in group A and 53% in the experimental group during 60 minutes of anaesthesia. These increases in the minute volume were significant. The main cause for this increase is the increase in respiratory rate without an appreciable change in the tidal volume. This increase in minute volume differs from the reports of Hall and Norris (1958), Dobkin and Fedoruk (1961), Dobkin et al. (1961) and Fisher (1961), the reason being that the respiratory rate in their studies fell whilst in the present study the respiratory rate increased significantly as anaesthesia progressed.

In group B, the minute volume showed no significant increase during anaesthesia despite the significant rise in the respiratory rate, the explanation being the significant fall in the tidal volume of this group.

9.3b Minute volume and body weight:

The relationship between the minute volume and body weight shows a significant corelation ($P < 0{\cdot}001$ for group A, and $P < 0{\cdot}05$ for group B). Minute volume became progressively and significantly larger with increasingly heavy dogs, but the extent of the difference was only about half the difference found with the tidal volume. This was because the respiratory rate in large dogs was much slower than for small dogs.

The net effect on the corelation of minute ventilation with body weight is an increase, but its extent is not so great as would be expected from the increase of tidal volume, the respiratory rate behaving in an inverse relationship as the body weights became greater.

9.3c Minute volume and posture:

The minute ventilation of dogs of comparable body weights is very similar in each of the three postures but in group A the dorsal subgroup had the highest minute volume. The relatively greater minute volume in this posture was achieved despite the smallest tidal volume because the respiratory rates were the highest of the three subgroups.

Comparison of the two lateral postures reveals an interesting difference between the smallest and the largest dogs. The larger dogs in the right lateral position - with the larger lung dependant and presumably more compressed - had considerably lower tidal volumes than those in the left lateral position. The minute ventilation of these dogs was also smaller than the values in the left lateral position by an amount comparable with the changed tidal volume. With the smaller dogs in the right and left lateral positions - the right lateral position revealed a greater tidal volume, perhaps because of the lesser degree of compression exerted on the diaphragm and lungs, by the abdominal content.

9.4 PULSE RATE

9.4a Pulse rate during anaesthesia:

Normal pulse rate values reported for dogs at rest vary from 72 to 200 beats per minute (Clark, 1927) and from 80 to 100 beats per minute (Boddie, 1969), (1.4a). In the present study the pulse rate after 10 minutes of anaesthesia varied from 80 to 206 beats per minute and the mean was 147·7. As anaesthesia was progressively continued the pulse rate slowed progressively to a mean value of 115·4 beats per minute. This significant decrease during anaesthesia is in close agreement with many other reports in man and animals (1.4b). In horses, thiopentone has been shown to cause an initial elevation of pulse rate (Tavernor and Lees, 1970) and the subsequent fall is attributed to hypotension following induction of anaesthesia.

9.4b Pulse rate and body weight:

Statistical analysis of the relationship of pulse rate to body weight during anaesthesia revealed no corelation. No relevant reference was found in the literature.

9.4c Pulse rate and posture:

No significant difference was found in pulse rate between left lateral, right lateral and dorsal postures during anaesthesia. However, Mitchell and Littlejohn (1972), found that the pulse in horses in the dorsal posture, showed a marked delay in the return to normal compared with the lateral positions. In man, Eggers et al. (1963) found little or no change in the pulse rate in relation to changing body positions.

10.0 BIOCHEMICAL PARAMETERS

10.1 ARTERIAL CARBON DIOXIDE TENSION

10.1a During anaesthesia:

The increase in the carbon dioxide tension of the arterial blood found in the animals of group A and the experimental dogs of this study gives some information regarding the extent of carbon dioxide retention in the body of spontaneously breathing dogs. Despite the increase in the minute volume, attained by an increase in respiratory rate, the increased retention of carbon dioxide indicated that the compensatory changes in ventilation have been inadequate to achieve clearance of carbon dioxide. The possibility of rebreathing was minimised by delivering fresh gas flow rates in excess of the estimated normal minute volume of the animal. Despite this, some of the dogs had higher minute volumes, indicating that some degree of rebreathing could have occurred. However, the extent of this retention of carbon dioxide as indicated by maximum mean values of P_aCO_2 51·3 mmHg in group A, clinical cases and P_aCO_2 56·0 mmHg in the experimental dogs does not result in a dangerous degree of respiratory acidosis. Similar results have been reported in animals and man (2.1b). Levels in excess of 74·0 mmHg P_aCO_2 have been stated as giving rise to cardiac arhythmias (Nunn, 1971).

10.1b Effect of body position:

In this investigation in the group A, clinical cases, the elevation of P_aCO_2 was significantly greater in the dorsal position than the lateral positions indicating less effective gas exchange in this position. In experimental dogs the difference in the P_aCO_2 between the dorsal and the lateral groups was less marked, which may well be due to the smaller number of animals monitored.

A greater retention of carbon dioxide in the dorsal position than in the lateral positions was reported by Mitchell and Littlejohn (1972) in horses.

10.2 ARTERIAL BLOOD pH AND STANDARD BICARBONATE

10.2a During anaesthesia:

Blood pH decreased progressively during anaesthesia proportional to the retention of carbon dioxide. This fall in blood pH was accompanied by a very slight and transient increase in the standard bicarbonate of the blood. A possible cause for the rise in the standard bicarbonate values recorded at 15 minutes after induction in the clinical dogs is the injection of the highly alkaline (pH 11) thiopentone sodium. This suggestion attracts further support when, in the experimental group, it is seen that the elevation of the standard bicarbonate levels after 30 minutes of anaesthesia is less marked. The standard bicarbonate values after 60 minutes of anaesthesia are comparable in both the clinical and experimental dogs. These changes indicate that the acidaemia is mainly of respiratory origin. Similar findings have been reported in man and animals (2.2b and 2.3b). Millar and Marshall (1965) and Scott and Slawson (1968), observed a fall in the standard bicarbonate indicating that a metabolic acidosis contributed to the drop in blood pH during anaesthesia. Millar and Marshall have attributed the fall in the standard bicarbonate to the difference between the log P_aCO_2/pH equilibration line for blood in vitro and its relationship with actual bicarbonate levels in the whole organism. However, neither Millar or his colleagues (1965), nor Scott and Slawson (1968) commented on the arterial blood oxygen tension of their patients. Changes in adequacy of perfusion or reduction in P_aO_2 of the patients will cause tissue hypoxia, leading to a drop in the level of the standard bicarbonate in the blood.

10.2b <u>Effect of posture</u>:

This study has shown that the drop in the arterial pH in differing postures was proportionate to the increase in the P_aCO_2 in the respective body positions, in both clinical and experimental groups.

Regarding the changes in the standard bicarbonate in different body positions, the absence of a significant difference between the mean values recorded in left lateral, right lateral and dorsal positions conforms with reports of Scott, et al. (1966), and Scott and Slawson (1968) in human patients.

10.3 ARTERIAL OXYGEN TENSION

10.3a During anaesthesia:

The control P_aO_2 values recorded for some dogs in the study appear to be unreasonably high for animals breathing air. Possible reasons for high readings include aerobic contamination of the samples during collection, although this does not seem the likely cause as the P_aCO_2 values are in an acceptable range, or contamination at the time of introducing the blood sample to the PO_2 electrode. Change of accuracy by the electrode was minimised by frequent recalibration although this was performed using gases in contradistinction to the sample under study being blood. There was considerable variation in the P_aO_2 of the blood samples collected from clinical dogs. Unlike carbon dioxide, which in dogs breathing normally has comparable opportunity for excretion, P_aO_2 is influenced by the level of oxygen available in the inspired gas mixture. Throughout the clinical series an elevation of P_aO_2 was achieved by administering a high oxygen tension in the inspired gas but as an exactly equal mixture of oxygen and nitrous oxide could not always be assured, the arterial oxygen values merely represent those that pertained in the series of clinical cases available and were not appropriate for statistical analysis. However, in the experimental dogs which received a constant mixture of equal parts of oxygen and nitrous oxide in a non-rebreathing system, the influence of duration of anaesthesia on their P_aO_2 could be reliably interpreted. The significant rise of P_aO_2 which occured in the early stage of anaesthesia in this experimental group corresponded with a similar change in the clinical group. This rise in P_aO_2 continued during anaesthesia, but this rate of increase was slow and not statistically significant.

10.3b Effect of posture:

In dorsally recumbent dogs the P_aO_2 was found to be lower than in both of the lateral positions. This observation in P_aO_2 conforms with the poorer ventilation in this position. Mitchell and Littlejohn (1972), have reported similar changes in horses.

10.4 HAEMOGLOBIN CONCENTRATION

10.4a During anaesthesia:

The fact that, in this study, anaesthesia was found to result in a significant decrease in the haemoglobin concentration compares favourably with the findings of O'Brien and Heath (1968) in sheep.

The results of Dobkin and Fedoruk (1961) and of Dobkin et al. (1961) in dogs, which indicates no change in the haemoglobin concentration, are at variance with this report. However, these authors results are questioned because the control blood samples on which they based the extent of changes in the haemoglobin concentration can not be accepted as samples representative of the normal state. Their blood samples were collected after premedication with perphenazine and induction with thiopentone, which have been shown to have a marked influence on the haemoglobin concentration and haematocrit, (3.1c).

In contrast to the stimulating effects of ether or chloroform on the sympathetic nervous system, halothane and the barbiturates appear to exert a depressing effect on the sympathetic system (Raventos, 1956 and O'Brien and Heath, 1968). This supression of the sympathetic activity causes atony of the splenic musclature and dilatation with consequent pooling particularly of red blood corpuscles from the circulation.

Haemoglobin concentration or haematocrit can be influenced by factors such as blood loss during surgery and restoration of intravascular volume from the extracellular fluid. The role of blood loss was not measured in this study but evidence of a fall in haemoglobin concentration being associated with anaesthesia is provided by the significant decrease evident in the clinical dogs in the 15 minute samples before surgery commenced and by the progressive nature of the decrease in the experimental dogs throughout the 60 minutes of anaesthesia when no surgery was superimposed.

10.5 CLINICAL SIGNIFICANCE OF THE RELATIONSHIP BETWEEN PARAMETERS:

Although there is a modest increase in the respiratory minute volume as anaesthesia progresses, this increase did not prevent the biochemical changes which resulted in increased P_aCO_2 and lowering of the pH. At the end of 60 minutes most patients showed marked change in these parameters. There are a number of reasons why the increase of minute volume may not effect improvement of alveolar ventilation and so prevent these biochemical changes. These are:-

The anaesthetic equipment increase the total volume of dead space and hence curtails the effective proportion of gas which can pass between the alveoli and the exterior. This increased dead space is however, slightly reduced by the use of an endotracheal tube which bypasses the naso-pharyngeal dead space.

Apparatus in which there is resistance to overflow of expired gases causes dilatation of the tracheal-broncheal tree, consequently the dead space is increased when the end-tidal pressure is raised. The net effect of this reduced ventilation is complicated by its effect on raising the functional residual capacity which reduces the tendency to progressive alveolar collapse during anaesthesia.

The effect of an increased end-tidal pressure may curtail the central (pulmonary) blood volume with a consequent diminution in the perfusion of some alveoli.

The efficiency of gas exchange in the lung is frequently reduced during anaesthesia by a large increase of venous admixture, due mainly to alveolar collapse; mismatching of the ventilation and the perfusion of individual alveoli; and direct shunting of unoxygenated blood through pulmonary arterio-venous anastomosis. Low levels of P_aO_2 therefore readily arise when patients have a high degree of venous admixture in addition to grossly subnormal haemoglobin concentration because the venous fraction in the mixed arterial blood is severely desaturated. Halothane anaesthesia, by its effect in depressing cardiac output, would accentuate any such desaturation of the venous fraction.

The increase of minute volume achieved by a speeding up of respiratory frequency is relatively ineffective in improving alveolar ventilation compared with an increase achieved by increasing tidal volume. In the present investigation tidal volume was rarely increased and in the great majority of the dogs it remained unchanged during anaesthesia.

Although no difference was found in tidal volume values in different body positions, the greater increase in P_aCO_2 and the relatively lower P_aO_2 values in the dorsal posture compared with the lateral postures, demonstrates the greater impairment of the alveolar gas exchange in the dorsal posture despite the higher minute volume and the increased respiratory rate recorded in that position.

From the above comments it is manifest that the monitoring of blood gas tensions, particularly P_aCO_2 and pH during anaesthesia is of significant consequence. This is expecially so when the animal is in dorsal recumbency and when anaesthesia is prolonged. It has been shown that the compensatory attempts by anaesthetised dogs to increase their ventilation is achieved by raising the respiratory rate. When P_aCO_2 rises to unacceptable levels it will become necessary to artificially ventilate the lungs. Intermittent positive pressure ventilation should be effected by increasing the patients tidal volume rather than by changing its respiratory frequency.

The ability of the blood to transport and release large quantities of oxygen is of great importance. Oxygen is carried in two forms. The greater part is in a reversible chemical combination with haemoglobin in the red blood corpuscles while a smaller part is in a solution in the plasma and intracellular fluid. In any circumstances where dogs have unusually low haemoglobin concentration the amount of oxygen carried will be reduced so that an appropriate increase in blood flow is necessary to provide adequate compensation.

The PO_2 of the arterial blood in situations of high venous admixture can be severely reduced by low venous oxygen tensions which occur in severe haemoglobin depletion. The significance of determining the haemoglobin concentration or the haematocrit levels is therefore also a matter which could be of critical importance to the well being of the patientsboth prior to and during anaesthesia. This laboratory test has special significance when anaesthesia with barbiturates and/or halothane is used. It is also of clinical significance in many other circumstances which result in loss of effective oxygen transport in the blood, for example oligaemic shock, dilated spleen, carbon monoxide poisoning and severe haemorrhage. With such conditions these high risk patients may require blood transfusion to restore the haemoglobin to normal safe levels.

CONCLUSION

Tidal volume showed no appreciable change throughout 60 minutes of anaesthesia. A significant relationship between body weight and tidal volume has been established. In the 100 dogs recorded the relationship is represented by the equation $y = 58{\cdot}88 + 7{\cdot}225\ x$, where y is tidal volume (ml) and x is body weight (kg). The three postures in which dogs were maintained during anaesthesia had no significant effect on tidal volume.

In all dogs the respiratory rate showed a progressive and significant increase during 60 minutes of anaesthesia. An expected significant inverse relationship between body weight and respiratory rate was observed.

The minute volume increased in the three groups of dogs studied, and as the tidal volume remained relatively unchanged this increase was a consequence of the increase of the respiratory rate. The relationship of body weight to minute volume is represented by the equation of the line $y = 2{\cdot}344 + 0{\cdot}106\ x$, where y is minute volume (litres) and x is body weight (kg). In lateral postures the minute volume values were comparable. In dorsal posture however, the minute volume values were higher than those of lateral postures because of the faster respiratory rate in the dorsal posture.

The retention of carbon dioxide was significant. However, carbon dioxide did not attain dangerous levels, but the upper range of values recorded in animals maintained in dorsal recumbency indicates that particularly in this posture P_aCO_2 values are significantly higher and regular monitoring may be justified.

The fall in arterial pH with the slight changes in the standard bicarbonate, indicate that the observed acidosis is mainly of respiratory origin. The increase in minute volume resulted from increased frequency of respiration rather than by an increase of tidal volume. However, despite the increase in minute volume the elevated P_aCO_2 indicates that the alveolar ventilation or gaseous exchange during anaesthesia in spontaneously breathing dogs is nevertheless impaired rather than being improved.

Mean values of P_aO_2 in the range 190 mmHg were obtained with the anaesthetic gas mixture containing about 50% oxygen. In lateral postures the extent of the increase in P_aO_2 was comparable with, but higher than its extent in dorsal recumbency. The lower P_aO_2 values for the dorsal group taken in conjunction with the greater elevation of P_aCO_2 confirms that the alveolar ventilation is poorer in this position than in the laterally recumbent animals.

Pulse rate fell progressively during maintenance of anaesthesia from peak mean values of about 147·4 beats per minute 10 minutes after induction of anaesthesia, to 115·4 beats per minute towards the 60 minute check. No relationship was demonstrable between pulse rate and body weight of dogs or between the pulse behaviour and the postures in which the dogs were maintained during anaesthesia.

Haemoglobin concentration was found to fall significantly from the mean control values of 14·83 gm per 100 ml to the mean values of 12·57 gm per 100 ml after 60 minutes of anaesthesia. This decrease in the haemoglobin concentration may be due to the reported accumulation of the red cells in the spleen (3.2). In left lateral, right lateral and dorsal postures the difference in haemoglobin concentration was not significant. The establishment of normal parameters and the changes that take place during anaesthesia establish the importance and the value of monitoring the biochemical changes that take place. The P_aCO_2 and haemoglobin concentration are of special significance and in their control positive pressure ventilation and blood transfusion are important remedial procedures.

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APPENDIX I

Individual details of the dogs studied during anaesthesia for routine surgery.

Case numbers	Body weight (kg)	Age (yrs.)	Sex	Breed	Operative indication
A1	18·6	0·5	M	Terrier	Fracture tibia.
A2	27·8	2·0	M	Labrador	Fracture femur.
A3	15·6	7·0	F	Collie	Anal fistula.
A4	24·4	6·0	F	Collie	Repair cruciate ligament.
A5	31·0	7·0	F	Airedale	Aural resection.
A6	9·0	0·2	M	Pyr.Mt.Dog	Fracture humerus.
A7	28·0	1·5	M	Dalmation	Rupture of dig. flex. tendon.
A8	15·6	1·0	F	Rough Collie	Fracture femur.
A9	16·0	6·5	F	Shet. Collie	Fracture of nasal bone.
A10	34·6	3·5	M	Labrador	Salivary cyst.
A11	22·0	3·5	F	Labrador	Ear cleaning
A12	24·6	0·5	M	Alsatian	Fracture humerus.
A13	13·0	2·5	F	Terrier	Fracture femur.
A14	7·5	4·5	F	Collie	Fracture femur.
A15	23·0	4·0	M	Poodle	Repair cruciate ligament.
A16	17·2	2·0	M	Collie	Remove bone plate.
A17	25·0	1·0	F	Collie	Fracture humerus.
A18	22·5	3·5	M	Spaniel	Fracture femur.
A19	23·5	10·0	M	Terrier	Skin wounds.
A20	31·0	7·0	F	Airedale	Aural resection.
A21	30·0	1·0	M	Red Setter	Fracture femur.
A22	11·8	0·6	F	Alsatian	Fracture humerus.
A23	31·5	4·0	M	Labrador	Broken tooth.
A24	34·0	3·5	M	Labrador	Ectropion.
A25	30·2	4·0	F	Labrador	Tumour upper jaw.

APPENDIX I (cont'd.)

Case numbers	Body weight (kg)	Age (yrs.)	Sex	Breed	Operative indication
A26	42·6	1·5	M	Rotweiller	Fracture femur.
A27	4·5	1·0	M	Yorkie	Fracture tibia.
A28	8·3	0·5	M	Terrier	Fracture femur.
A29	7·2	1·0	F	Cairn	Salivary cyst.
A30	18·8	1·0	M	Labrador	Extirpation of eyeball.
A31	36·2	6·0	F	Labrador	Pyometra O - H.*
A32	16·0	13·0	F	Collie	Mammary tumour.
A33	33·6	8·0	F	Labrador	Spay O - H.*
A34	15·6	8·0	F	Spaniel	Pyometra O - H.*
A35	23·5	7·5	M	Alsatian	Exploratory laparotomy.
A36	15·0	12·5	M	Shet. Collie	Urinary calculi.
A37	45·7	9·5	F	Alsatian	Splenectomy.
A38	23·2	8·5	F	Boxer	Pyometra O - H.*
A39	11·0	11·0	F	Terrier	Mammary tumour.
A40	31·6	2·0	F	Labrador X	Vaginal tumour.
A41	49·0	9·0	M	Alsatian	Anal fistula.
A42	23·2	0·7	F	Old Eng.S.D.	Section of pectineous muscle.
A43	29·8	10·0	F	Labrador	Spay O - H.*
A44	14·2	10·0	F	Spaniel	Mammary tumour.
A45	15·8	10·0	F	Terrier	Mammary tumour.
A46	7·3	12·5	F	Fox Terrier	Mammary tumour.
A47	14·8	3·5	F	Terrier	Spay O - H.*
A48	16·1	9·5	F	K.C.Spaniel	Urinary calculi.
A49	10·8	10·5	F	Poodle	Mammary tumour.
A50	16·2	12·5	F	Poodle	Mammary tumour.

* Ovariohysterectomy.

APPENDIX IIa

Tidal volume values (mls) of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A1	18·6	170	168	158	168	166	160
A2	27·8	306	244	263	260	260	257
A3	15·6	69	128	136	100	100	96
A4	24·4	430	289	258	286	312	311
A5	31·0	310	285	294	323	320	306
A6	9·0	115	94	105	111	113	119
A7	28·0	252	287	335	314	319	351
A8	15·6	256	289	300	241	256	244
A9	16·0	134	165	156	164	161	157
A10	34·6	444	391	415	314	482	488
A11	22·0	125	208	237	288	245	234
A12	24·6	252	259	249	215	267	303
A13	13·0	142	201	179	201	200	291
A14	7·5	90	89	79	88	103	105

APPENDIX IIa

Tidal volume values (mls) of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A15	23·0	307	383	187	177	164	160
A16	17·2	214	280	79	129	143	150
A17	25·0	315	291	302	351	315	263
A18	22·5	194	270	224	213	194	216
A19	23·5	298	188	177	150	173	178
A20	31·0	303	274	260	280	286	263
A21	30·0	375	362	344	360	347	337
A22	11·8	272	241	228	205	201	144
A23	31·5	104	367	483	470	506	442

APPENDIX IIa (cont'd.)

<u>Tidal volume values (mls) of clinical dogs in right lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A24	34·0	217	316	274	248	235	258
A25	30·2	350	500	392	373	362	356
A26	42·6	453	439	347	328	341	382
A27	4·5	89	152	63	77	74	86
A28	8·3	165	142	141	119	122	128
A29	7·2	143	90	92	90	96	93
A30	18·8	401	342	365	355	305	291

APPENDIX IIa

Tidal volume values (mls) of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A31	36·2	301	332	285	242	249	260
A32	16·0	169	184	214	198	200	200
A33	33·6	121	219	257	240	266	227
A34	15·6	87	96	115	93	95	107
A35	23·5	154	319	617	544	470	444
A36	15·0	103	97	104	106	114	109
A37	45·7	342	338	186	195	221	210
A38	23·2	494	300	216	190	193	190
A39	11·0	91	111	98	112	78	102
A40	31·6	188	130	219	218	210	206
A41	49·0	589	410	412	455	446	420

APPENDIX IIa (cont'd.)

Tidal volume values (mls) of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A42	23·2	439	438	456	330	416	310
A43	29·8	202	254	236	234	237	254
A44	14·2	283	121	168	173	172	175
A45	15·8	141	234	177	167	156	195
A46	7·3	234	109	96	117	157	143
A47	14·8	123	142	142	125	121	125
A48	16·1	114	116	106	114	111	112
A49	10·8	71	60	53	43	40	47
A50	16·2	67	60	137	95	101	98

APPENDIX IIb

Respiratory rate values (breaths per min) for the clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A1	18·6	15	17	18	19	22	25
A2	27·8	15	17	19	20	22	24
A3	15·6	18	18	53	34	36	37
A4	24·4	10	9	14	12	14	14
A5	31·0	24	31	32	33	35	37
A6	9·0	28	16	31	27	27	24
A7	28·0	25	17	17	22	21	41
A8	15·6	8	8	5	11	9	9
A9	16·0	25	33	27	29	32	34

APPENDIX IIb (cont'd.)

Respiratory rate values (breaths per min) for the clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A10	34·6	8	11	13	29	22	25
A11	22·0	17	12	14	16	18	20
A12	24·6	36	34	39	38	36	32
A13	13·0	13	12	14	14	14	13
A14	7·5	42	81	75	87	65	60

APPENDIX IIb

Respiratory rate values (breaths per min) for the clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A15	23·0	7	12	30	30	32	35
A16	17·2	7	5	17	14	15	15
A17	25·0	8	9	12	14	14	18
A18	22·5	17	20	23	26	48	32
A19	23·5	13	24	29	22	24	22
A20	31·0	16	19	24	32	29	33
A21	30·0	7	9	12	13	13	13
A22	11·8	9	11	16	21	22	25

APPENDIX IIb (cont'd.)

Respiratory rate values (breaths per min) for the clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A23	31·5	27	3	3	5	9	10
A24	34·0	32	22	23	39	35	37
A25	30·2	3	6	11	11	12	14
A26	42·6	10	14	19	22	23	25
A27	4·5	14	16	20	21	19	21
A28	8·3	20	28	37	35	38	39
A29	7·2	28	34	40	44	43	45
A30	18·8	7	6	6	8	10	11

APPENDIX IIb

<u>Respiratory rate values (breaths per min) for the clinical dogs in dorsal posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A31	36·2	12	14	17	26	26	27
A32	16·0	18	16	18	22	20	20
A33	33·6	14	13	12	25	16	19
A34	15·6	45	41	36	51	50	51
A35	23·5	36	8	6	8	10	16
A36	15·0	40	41	35	32	39	37
A37	45·7	19	12	37	43	59	71
A38	32·2	8	8	19	28	30	35
A39	11·0	27	59	57	50	63	58
A40	31·6	40	77	38	37	40	42

APPENDIX IIb (cont'd.)

Respiratory rate values (breaths per min) for the clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A41	49·0	18	25	26	29	25	27
A42	23·2	7	8	8	19	9	10
A43	29·8	22	17	36	40	41	39
A44	14·2	20	36	25	28	28	30
A45	15·8	40	16	35	40	45	44
A46	7·3	8	11	18	9	7	9
A47	14·8	73	79	77	81	91	89
A48	16·1	30	56	58	54	54	56
A49	10·8	51	89	105	90	82	85
A50	16·2	81	95	68	70	72	64

APPENDIX IIc

Minute volume values (litres per min) of the clinical dogs in the left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A1	18·6	2·55	2·85	2·84	3·20	3·64	3·75
A2	27·8	4·59	4·15	5·00	5·20	5·72	6·17
A3	15·6	1·25	2·30	7·20	1·40	3·40	3·60
A4	24·4	1·29	2·60	3·62	4·00	3·75	4·35
A5	31·0	7·68	8·85	9·40	10·65	11·20	11·35
A6	9·0	3·21	1·50	3·26	3·00	2·90	2·85
A7	28·0	6·30	4·88	5·70	6·90	6·70	14·40
A8	15·6	2·05	2·31	1·50	2·65	2·30	2·20
A9	16·0	3·35	5·45	4·22	4·75	5·15	5·34

APPENDIX IIc (cont'd.)

Minute volume values (litres per min) of the clinical dogs in the left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
A10	34·6	3·55	4·30	5·40	9·10	10·60	12·20
A11	22·0	2·13	2·50	3·30	4·60	4·41	4·68
A12	24·6	9·07	8·81	9·72	8·15	9·60	9·70
A13	13·0	1·85	2·41	2·50	2·82	2·80	2·78
A14	7·5	3·78	3·85	8·90	5·90	7·68	6·30

APPENDIX IIc

Minute volume values (litres per min) of the clinical dogs in the right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A15	23·0	2·15	4·60	5·60	5·30	5·30	5·60
A16	17·2	1·50	1·40	1·35	1·80	2·15	2·25
A17	25·0	2·52	2·62	2·62	4·80	4·25	4·77
A18	22·5	3·30	5·39	5·15	5·54	9·30	6·90
A19	23·5	3·88	4·50	5·10	3·30	4·15	3·92
A20	31·0	4·85	5·21	6·25	8·95	8·30	8·70
A21	30·0	2·63	3·26	4·13	4·72	4·51	4·38
A22	11·8	2·45	2·65	3·65	4·31	4·43	4·62

APPENDIX IIc (cont'd.)

<u>Minute volume values (litres per min) of the clinical dogs in the right lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A23	31·5	2·80	1·10	1·45	2·35	4·55	4·87
A24	34·0	6·95	6·95	6·31	9·69	8·75	9·55
A25	30·0	1·05	3·00	4·31	4·10	4·35	4·99
A26	42·6	4·53	6·15	6·60	7·21	7·84	9·55
A27	4·5	1·25	2·45	1·25	1·61	1·40	1·81
A28	8·3	3·30	3·98	5·22	4·18	4·63	5·00
A29	7·2	4·00	3·05	3·68	3·96	4·15	4·20
A30	18·8	2·81	2·05	2·21	2·84	3·05	3·20

APPENDIX IIc

Minute volume values (litres per min) of the clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
A31	36·2	3·61	4·65	4·85	6·30	6·92	6·75
A32	16·0	3·05	2·95	3·85	4·35	4·00	4·00
A33	33·6	1·70	2·85	3·09	6·05	4·25	4·32
A34	15·6	3·92	3·95	4·15	4·75	4·75	5·45
A35	23·5	5·55	2·55	3·70	4·35	4·70	7·10
A36	15·0	4·10	3·98	3·64	3·38	4·45	4·05
A37	45·7	6·50	4·05	6·88	8·39	13·05	14·90
A38	23·2	3·95	2·40	4·10	5·32	5·80	5·90
A39	11·0	2·45	6·55	5·60	5·61	4·90	5·95
A40	31·6	7·50	10·00	8·35	8·05	8·40	8·65

APPENDIX IIc (cont'd,)

<u>Minute volume values (litres per min) of the clinical dogs in dorsal posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A41	49.0	10.60	10.25	10.70	13.20	11.15	11.35
A42	23·2	3·07	3·50	3·65	3·30	3·74	3·10
A43	29·8	4·45	4·32	8·50	9·35	9·70	9·90
A44	14·2	5·65	4·35	4·20	4·85	4·82	5·25
A45	15·8	5·65	3·75	6·20	6·68	7·00	8·60
A46	7·3	1·87	1·20	1·72	1·05	1·10	1·29
A47	14·8	9·00	11·25	10·90	10·10	11·00	11·10
A48	16·1	3·41	6·58	6·16	6·15	6·00	6·28
A49	10·8	3·60	5·35	5·52	3·87	3·25	4·00
A50	16·2	5·40	5·70	5·20	6·65	7·28	6·28

APPENDIX IId

Pulse rates (beats per min) of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A1	18·6	176	172	152	136	126	120
A2	27·8	160	152	144	140	128	124
A3	15·6	124	120	160	120	136	128
A4	24·4	140	124	124	100	88	86
A5	31·0	149	128	116	120	116	104
A6	9·0	156	136	120	106	106	104
A7	28·0	160	140	128	140	124	128

APPENDIX IId (cont'd.)

Pulse rates (beats per min) of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A8	15·6	198	162	160	120	124	120
A9	16·0	136	140	120	124	120	116
A10	34·6	180	172	160	156	148	134
A11	22·0	144	136	124	120	116	100
A12	24·6	148	152	128	132	136	132
A13	13·0	120	116	104	108	104	100
A14	7·5	168	120	120	128	108	104

APPENDIX IId

Pulse rates (beats per min) of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A15	23·0	162	108	120	132	124	120
A16	17·2	106	148	124	116	120	112
A17	25·0	160	104	120	124	126	116
A18	22·5	80	96	134	144	144	140
A19	23·5	168	128	114	100	96	104
A20	31·0	160	124	120	108	104	100
A21	30·0	138	120	100	104	136	126
A22	11·8	136	168	150	132	128	124

APPENDIX IId (cont'd.)

<u>Pulse rates (beats per min) of clinical dogs in right lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A23	31·5	206	168	116	100	108	100
A24	34·0	138	136	160	144	144	138
A25	30·2	120	128	120	120	116	124
A26	42·6	152	144	124	120	120	116
A27	4·5	124	116	116	108	104	100
A28	8·3	140	132	120	116	112	104
A29	7·2	156	144	138	134	134	132
A30	18·8	164	142	128	100	96	92

APPENDIX IId

Pulse rates (beats per min) of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
A31	36·2	144	132	148	142	138	134
A32	16·0	192	200	136	132	122	118
A33	33·6	112	140	128	112	144	108
A34	15·6	144	140	140	132	132	132
A35	23·5	108	144	92	88	124	120
A36	15·0	108	108	112	120	148	120
A37	45·7	160	156	128	124	128	120
A38	23·2	168	150	142	120	116	112
A39	11·0	120	148	148	132	128	120
A40	31·6	158	144	120	124	120	116

APPENDIX IId (cont'd.)

Pulse rates (beats per min) of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
A41	49·0	104	96	96	92	84	80
A42	23·2	164	120	108	92	100	88
A43	29·8	168	140	168	132	136	132
A44	14·2	140	132	120	116	108	96
A45	15·8	180	160	144	132	132	130
A46	7·3	164	140	124	116	112	108
A47	14·8	116	112	116	112	108	100
A48	16·1	156	120	100	130	128	120
A49	10·8	180	156	148	142	138	140
A50	16·2	148	140	132	136	138	134

APPENDIX IIIa

Arterial carbon dioxide tension of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial carbon dioxide tension (mmHg). Preanaes. sample	15 min anaesthesia	Completion of surgery
A1	27·8	27·0	52·0	60·0
A2	18·6	30·0	48·0	58·0
A3	15·6	36·4	52·8	51·9
A4	24·4	28·7	50·6	39·5
A5	31·0	41·5	51·2	49·7
A6	9·0	33·1	40·8	41·0
A7	28·0	36·6	45·3	43·9
A8	15·6	34·0	44·9	48·1
A9	16·0	27·5	41·8	38·3
A10	34·6	35·6	56·7	50·8
A11	22·0	30·7	42·7	38·0
A12	24·6	37·2	50·8	52·0
A13	13·0	31·0	38·2	41·0
A14	7·5	32·5	55·0	66·0

APPENDIX IIIa

<u>Arterial carbon dioxide tension of clinical dogs in right lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Arterial carbon dioxide tension (mmHg). Preanaes. sample	15 min anaesthesia	Completion of surgery
A15	23·0	38·5	43·0	41·0
A16	17·2	35·7	43·9	46·2
A17	25·0	36·9	44·4	39·0
A18	22·5	30·5	44·4	46·4
A19	23·5	28·1	51·5	75·1
A20	31·0	41·5	48·2	52·6
A21	30·0	34·1	45·3	51·8
A22	11·8	34·0	45·6	51·5
A23	31·5	35·5	57·9	61·1
A24	34·0	28·3	45·1	51·3
A25	30·2	40·0	62·0	63·1
A26	42·6	36·3	45·9	46·7
A27	4·5	35·5	49·2	49·7
A28	8·3	44·9	54·6	51·2
A29	7·2	37·4	52·3	54·0
A30	18·8	28·5	47·8	46·0

APPENDIX IIIa

Arterial carbon dioxide tension of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial carbon dioxide tension (mmHg). Preanaes. sample	15 min anaesthesia	Completion of surgery
A31	36·2	32·0	44·0	47·0
A32	16·0	33·8	52·5	58·8
A33	33·6	28·2	52·8	57·1
A34	15·6	34·9	59·6	90·7
A35	23·5	31·7	44·0	38·6
A36	15·0	39·4	86·0	79·9
A37	45·7	26·5	41·5	51·5
A38	23·2	39·9	57·0	57·9
A39	11·0	30·8	44·9	53·8
A40	31·6	32·1	51·2	66·9
A41	49·0	31·4	45·2	39·7
A42	23·2	33·7	48·6	52·4
A43	29·8	34·2	57·4	59·4
A44	14·2	39·9	55·8	60·2
A45	7·3	34·1	59·6	54·1
A46	14·8	35·3	47·4	49·0
A47	16·1	33·9	63·8	73·0
A48	10·8	39·0	56·4	55·3
A49	16·2	42·0	54·0	59·6
A50	15·8	34·7	55·9	56·4

APPENDIX IIIb

Arterial pH values of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial pH Preanaes. sample	15 min anaesthesia	Completion of surgery
A1	18·6	7·450	7·270	7·180
A2	27·8	7·358	7·255	7·190
A3	15·6	7·491	7·339	7·330
A4	24·4	7·455	7·308	7·332
A5	31·0	7·382	7·321	7·288
A6	9·0	7·419	7·348	7·335
A7	28·0	7·390	7·322	7·316
A8	15·6	7·413	7·324	7·254
A9	16·0	7·410	7·300	7·297
A10	34·6	7·365	7·252	7·272
A11	22·0	7·388	7·281	7·266
A12	24·6	7·400	7·284	7·235
A13	13·0	7·403	7·321	7·261
A14	7·5	7·392	7·244	7·164

APPENDIX IIIb

Arterial pH values of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial pH		
		Preanaes. sample	15 min anaesthesia	Completion of surgery
A15	23·0	7·260	7·260	7·339
A16	17·2	7·358	7·301	7·294
A17	25·0	7·491	7·352	7·309
A18	22·5	7·454	7·305	7·307
A19	23·5	7·490	7·298	7·099
A20	31·0	7·382	7·327	7·281
A21	30·0	7·430	7·350	7·304
A22	11·8	7·340	7·254	7·232
A23	31·5	7·410	7·228	7·230
A24	34·0	7·361	7·263	7·224
A25	30·2	7·397	7·217	7·219
A26	42·6	7·382	7·294	7·324
A27	4·5	7·325	7·234	7·176
A28	8·3	7·400	7·332	7·299
A29	7·2	7·371	7·298	7·280
A30	15·8	7·333	7·212	7·254

APPENDIX IIIb

Arterial pH values of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial pH: Preanaes. sample	15 min anaesthesia	Completion of surgery
A31	36·2	7·365	7·250	7·260
A32	16·0	7·386	7·348	7·253
A33	33·6	7·501	7·278	7·226
A34	15·6	7·415	7·216	7·156
A35	23·5	7·421	7·328	7·338
A36	15·0	7·433	7·148	7·126
A37	45·7	7·365	7·217	7·155
A38	23·2	7·445	7·304	7·251
A39	11·0	7·400	7·199	7·051
A40	31·6	7·478	7·229	7·221
A41	49·0	7·410	7·342	7·329
A42	23·0	7·310	7·224	7·184
A43	29·8	7·406	7·229	7·215
A44	14·2	7·399	7·256	7·226
A45	7·3	7·383	7·150	7·146
A46	14·8	7·282	7·172	7·120
A47	16·1	7·372	7·210	7·140
A48	10·8	7·352	7·236	7·244
A49	16·2	7·278	7·191	7·194
A50	15·8	7·410	7·240	7·141

APPENDIX IIIc

Arterial oxygen tension of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial oxygen tension (mmHg). Preanaes. sample	15 min anaesthesia	Completion of surgery
A1	18·6	79·0	107·0	128·0
A2	27·8	119·0	142·0	160·0
A3	15·6	95·2	239·8	250·0
A4	24·4	93·7	208·7	185·7
A5	31·0	107·8	210·0	205·8
A6	9·0	102·0	155·6	175·5
A7	28·0	119·7	248·8	248·7
A8	15·6	117·2	262·5	231·4
A9	16·0	94·0	172·5	156·5
A10	34·6	139·2	217·5	195·0
A11	22·0	102·8	150·5	158·2
A12	24·6	122·0	211·1	201·0
A13	13·0	106·3	340·0	350·0
A14	7·5	109·0	240·0	230·0

APPENDIX IIIc

Arterial oxygen tension of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Arterial oxygen tension (mmHg). Preanaes. sample	15 min anaesthesia	Completion of surgery
A15	23·0	136·0	140·0	230·0
A16	17·2	102·0	240·0	218·0
A17	25·0	97·3	247·4	247·0
A18	22·5	108·0	157·4	279·0
A19	23·5	101·2	271·7	289·6
A20	31·0	107·8	135·6	135·0
A21	30·0	110·6	192·0	203·1
A22	11·8	107·4	345·0	353·0
A23	31·5	100·6	254·0	244·0
A24	34·0	105·5	241·1	166·0
A25	30·2	92·7	155·2	133·1
A26	42·6	100·5	206·3	204·7
A27	4·5	98·3	203·2	225·6
A28	8·3	126·1	255·7	250·0
A29	7·2	117·8	240·6	250·0
A30	18·8	124·0	245·0	266·0

APPENDIX IIIc

<u>Arterial oxygen tension of clinical dogs in dorsal posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Arterial oxygen tension (mmHg). Preanaes. sample	15 min anaesthesia	Completion of surgery
A31	36·2	101·0	116·0	112·0
A32	16·0	100·2	265·0	196·0
A33	33·6	57·1	232·5	137·5
A34	15·6	74·3	151·5	119·6
A35	23·5	115·3	321·3	258·1
A36	15·0	72·8	168·9	133·2
A37	45·7	77·0	186·5	152·3
A38	23·2	111·5	199·8	231·7
A39	11·0	110·7	182·9	154·1
A40	31·6	116·4	171·4	113·2
A41	49·0	104·0	218·1	173·0
A42	23·2	98·6	249·7	208·5
A43	29·8	133·5	197·7	132·5
A44	14·2	102·5	257·0	197·4
A45	7·3	114·8	196·7	153·1
A46	14·8	88·4	107·5	193·3
A47	16·1	98·9	130·0	127·6
A48	10·8	132·4	207·4	182·0
A49	16·2	78·6	179·0	105·0
A50	15·8	112·0	192·8	184·1

APPENDIX IIId

Standard bicarbonate values of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Standard bicarbonate (mEq/litre) Preanaes. sample	15 min anaesthesia	Completion of surgery
A1	27·8	18·5	19·7	19·0
A2	18·6	22·0	21·0	19·5
A3	15·6	24·0	26·0	25·5
A4	24·4	20·5	24·5	21·0
A5	31·0	23·0	21·0	23·5
A6	9·0	20·2	19·5	20·2
A7	28·0	21·2	21·8	21·0
A8	15·6	20·6	21·8	19·9
A9	16·0	18·5	20·7	18·5
A10	34·6	19·5	23·2	22·0
A11	22·0	18·2	19·8	18·5
A12	24·6	22·6	24·0	23·6
A13	13·0	19·0	19·2	19·1
A14	7·5	20·4	21·5	18·7

APPENDIX IIId

Standard bicarbonate values of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Preanaes. sample	15 min anaesthesia	Completion of surgery
		Standard bicarbonate mEq/litre)		
A15	23·0	16·0	19·0	21·5
A16	17·2	20·1	20·5	21·0
A17	25·0	26·5	24·0	20·0
A18	22·5	20·5	20·5	22·0
A19	23·5	20·5	22·7	21·0
A20	31·0	23·0	24·5	23·7
A21	30·0	21·5	23·5	25·0
A22	11·8	18·5	18·8	20·0
A23	31·5	22·0	23·0	23·8
A24	34·0	16·0	20·0	20·8
A25	30·2	24·0	24·5	25·0
A26	42·6	21·2	21·2	23·6
A27	4·5	18·1	20·2	18·1
A28	8·3	27·0	28·1	24·5
A29	7·2	21·3	24·5	24·7
A30	18·8	16·5	17·5	19·0

APPENDIX IIId

Standard bicarbonate values of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Standard bicarbonate (mEq/litre) Preanaes. sample	15 min anaesthesia	Completion of surgery
A31	36·2	19·0	18·5	20·0
A32	16·0	21·6	22·5	24·0
A33	33·6	21·5	23·0	22·2
A34	15·6	22·0	23·5	21·0
A35	23·5	19·0	21·5	20·0
A36	15·0	24·5	28·0	25·0
A37	45·7	17·0	16·0	13·5
A38	23·2	26·0	27·0	24·0
A39	11·0	20·0	16·0	14·6
A40	31·6	23·2	21·0	26·6
A41	49·0	19·5	23·6	20·5
A42	23·2	16·5	19·8	19·5
A43	29·8	20·5	23·3	23·5
A44	14·2	23·8	24·0	24·2
A45	7·3	20·0	20·4	18·5
A46	14·8	16·4	17·1	15·5
A47	16·1	19·3	24·8	24·2
A48	10·8	21·1	23·5	23·5
A49	16·2	18·9	19·0	20·2
A50	15·8	31·4	23·2	19·0

APPENDIX IV

Haemoglobulin values of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Haemoglobulin concentration (gm/100 ml) Preanaes. sample	15 min anaesthesia	Completion of surgery
A1	27·8	16·00	13·54	12·61
A3	15·6	15·40	14·49	12·76
A4	24·4	16·64	14·72	13·12
A5	31·0	15·20	12·96	9·92
A6	9·0	12·48	11·20	11·20
A8	15·6	17·50	15·36	15·30
A9	16·0	15·36	14·08	13·06
A10	34·6	16·80	15·04	14·53
A11	22·0	14·40	12·64	10·72
A12	24·6	15·36	13·60	13·12
A13	13·0	14·08	13·76	11·36

APPENDIX IV

Haemoglobulin values of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Haemoglobulin concentration (gm/100 ml) Preanaes. sample	15 min anaesthesia	Completion of surgery
A15	17·2	14·16	12·08	12·73
A16	23·0	17·95	16·33	16·65
A18	22·5	14·40	13·44	13·12
A20	31·0	15·20	11·20	9·92
A21	30·0	13·00	12·76	11·33
A22	11·8	10·88	10·67	9·34
A23	31·5	17·87	13·68	13·58
A24	34·0	15·68	13·28	13·44
A25	30·2	20·09	17·28	17·76
A26	42·6	16·96	14·40	13·60
A27	4·5	17·60	14·72	15·04
A28	8·3	14·75	11·60	13·49
A29	7·2	13·49	11·29	11·14
A30	18·8	13·70	13·40	13·00

APPENDIX IV

Haemoglobulin values of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Haemoglobulin concentration (gm/100 ml) Preanaes. sample	15 min anaesthesia	Completion of surgery
A31	36·2	14·69	14·20	13·61
A33	33·6	17·02	14·98	14·98
A34	15·6	12·72	10·28	10·51
A35	23·5	16·64	15·36	14·72
A36	15·0	13·60	13·44	12·16
A37	45·7	10·88	10·40	9·44
A38	23·2	16·00	12·96	14·24
A39	11·0	13·98	11·18	9·94
A40	31·6	16·78	14·12	12·89
A41	49·0	16·47	16·38	13·55
A42	23·2	13·18	10·73	11·61
A43	29·8	13·46	11·89	12·96
A44	14·2	10·56	11·68	11·20
A45	7·3	14·08	13·60	11·36
A46	14·8	14·08	12·32	12·80
A47	16·1	13·21	12·57	12·56
A48	10·8	13·69	10·46	12·61
A49	16·2	10·56	8·00	8·64
A50	15·8	16·32	13·12	11·52

APPENDIX V

Individual details of the dogs studied during anaesthesia for routine surgery, (Group B).

Case numbers	Body weight (kg)	Age (yrs.)	Sex	Breed	Operative indication
B1	9.5	7·0	M	Cairn	Cystotomy.
B2	39·0	2·0	M	Labrador	Cut paw.
B3	28·0	7·0	F	Labrador	Mammary tumour.
B4	15·3	13·0	F	Terrier	Teeth.
B5	4·5	11·5	F	Poodle	Teeth.
B6	28·0	3·0	F	Alsatian	Explore nasal discharge.
B7	11·0	9·0	F	Poodle	Splenectomy.
B8	9·9	13·0	F	Collie X	Teeth.
B9	13·6	12·0	F	Poodle	Teeth.
B10	8·5	11·0	M	Cairn	Teeth.
B11	25·0	2·0	M	Labrador	Castration.
B12	28·0	10·0	F	Labrador	Fracture femur.
B13	10·5	1·2	M	Labrador X	Teeth.
B14	9·0	0·5	F	Collie	Dislocated hip.
B15	19·0	2·5	M	Setter	Fracture femur.
B16	15·2	7·0	M	Spaniel	Teeth.
B17	11·0	11·0	F	West Highland White	Teeth.
B18	4·6	9·5	F	Poodle	Fracture jaw.
B19	21·5	9·0	M	Spaniel	Wart on eyelid.
B20	30·5	1·0	M	Alsatian	Fracture tibia.
B21	27·0	3·5	M	Collie	Fracture humerus.
B22	12·5	0·5	M	Collie X	Fracture tibia.
B23	25·5	4·0	M	Basset	Enlarged prostrate.
B24	40·0	7·0	M	Alsatian	Clear ears.
B25	13·0	9·5	F	Poodle	Mammary tumour.

APPENDIX V (cont'd.)

Case numbers	Body weight (kg)	Age (yrs.)	Sex	Breed	Operative indication
B26	20·0	1·0	M	Spaniel	Fracture femur.
B27	28·0	1·0	F	Labrador	Teeth.
B28	8·0	8·0	F	Collie X	Teeth.
B29	28·0	1·0	F	Labrador	Teeth.
B30	13·5	6·5	M	Cairn	Abdominal testicle.
B31	16·7	4·0	F	Collie	Laparotomy (liver biopsy).
B32	33·5	7·0	F	Labrador	Pyometra O - H.*
B33	7·5	8·0	F	Boston	Mammary tumour.
B34	5·0	11·0	F	West Highland White	Pyometra O - H.*
B35	11·0	4·0	F	Terrier	Spay O - H.*
B36	33·0	6·5	F	Labrador	Mammary tumour.
B37	9·5	14·5	M	Collie	Testicular tumour.
B38	11·5	5·5	F	Cairn	Pyometra O - H.*
B39	36·0	8·0	M	Terrier	Laparotomy.
B40	28·5	5·0	F	Labrador	Spay O - H.*
B41	25·0	10·0	F	Collie	Teeth.
B42	26·4	1·0	F	Labrador	Spay O - H. *
B43	39·0	8·0	F	Labrador	Pyometra O - H.*
B44	28·5	11·0	M	Cairn	Teeth.
B45	18·0	4·0	F	Spaniel	Mammary tumour.
B46	26·0	10·0	F	Boxer	Spay O - H.*
B47	7·0	9·0	F	Poodle	Mammary tumour.
B48	17·8	15·0	F	Labrador	Pyometra O - H. *
B49	13·0	1·5	M	Collie	Teeth.
B50	42·2	8·0	M	Alsatian	Cryosurgery anus.

*Ovariohysterectomy.

APPENDIX VIa

<u>Tidal volume values (mls) of clinical dogs in left lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B1	9·5	-	72	78	69	82	-
B2	39·0	330	316	350	395	300	280
B3	28·0	409	-	405	422	425	-
B4	15·3	200	267	252	-	-	-
B5	4·5	70	62	76	72	-	-
B6	28·0	416	487	396	381	-	-
B7	11·0	119	118	105	-	-	-
B8	9·9	124	118	88	114	110	130
B9	13·6	98	73	83	86	86	84
B10	8·5	64	75	71	69	-	-
B11	25·0	186	240	176	-	-	-
B12	28·0	204	200	-	186	165	-
B13	10·5	-	220	210	-	-	-

APPENDIX VIa (cont'd.)

Tidal volume values (mls) of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B14	9·0	75	75	77	85	-	-
B15	19·0	160	211	207	220	194	210
B16	15·2	264	241	200	175	224	198
B17	11·0	-	92	95	111	119	144
B18	4·6	77	-	73	74	63	73
B19	21·5	-	259	271	249	237	-
B20	30·5	410	323	415	254	-	-
B21	27·0	328	337	-	412	441	-

APPENDIX VIa (cont'd.)

Tidal volume values (mls) of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B22	12·5	-	137	138	137	120	-
B23	25·5	278	300	252	170	-	162
B24	40·0	311	306	372	360	310	305
B25	13·0	241	263	255	236	-	210
B26	20·0	276	206	256	233	277	-
B27	28·0	-	216	233	223	238	-
B28	8·0	64	75	71	74	66	-
B29	28·0	164	206	305	178	182	-

APPENDIX VIa

<u>Tidal volume values (mls) of clinical dogs in dorsal posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B30	13·5	79	102	75	70	81	71
B31	16·7	-	105	123	132	130	146
B32	33·5	333	382	254	253	245	241
B33	7·5	26	50	43	66	-	-
B34	5·0	-	58	66	71	63	66
B35	11·0	-	124	117	100	105	111
B36	33·0	-	215	222	210	235	241
B37	9·5	-	102	95	88	110	105
B38	11·5	-	61	53	52	55	53
B39	36·0	-	206	239	245	195	205

APPENDIX VIa (cont'd.)

Tidal volume values (mls) of clinical dogs in dorsal posture during anaesthesia.

Case number	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B40	28.0	200	155	177	172	170	168
B41	25.0	239	213	232	250	-	216
B42	26.4	320	116	222	215	225	-
B43	39.0	336	291	288	296	320	306
B44	28.5	270	360	251	189	165	197
B45	18.0	-	376	206	179	168	-
B46	26.0	310	281	204	220	216	206
B47	7.0	115	94	100	83	-	-
B48	17.8	83	73	70	66	64	-
B49	13.0	80	120	118	108	129	-
B50	28.0	-	309	286	278	-	-

APPENDIX VIb

Respiratory rate values (breaths per min) for the clinical dogs in left lateral posture during anaesthesia.

Case number	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B1	9·5	-	32	27	25	24	-
B2	39·0	15	15	16	10	18	21
B3	28·0	14	-	14	15	15	-
B4	15·3	6	9	11	-	-	-
B5	4·5	50	43	51	41	-	-
B6	28·0	3	4	7	10	-	-
B7	11·0	33	35	40	-	-	-

APPENDIX VIb (cont'd.)

<u>Respiratory rate values (breaths per min) for the clinical dogs in left lateral posture during anaesthesia.</u>

Case number	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B8	9·9	9	17	21	27	33	30
B9	13·6	23	46	30	35	38	40
B10	8·5	25	32	44	44	-	-
B11	25·0	15	30	42	-	-	-
B12	28·0	13	15	-	38	35	-
B13	10·5	-	7	7	-	-	-

APPENDIX VIb

Respiratory rate values (breaths per min) for the clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B14	9·0	34	42	58	56	-	-
B15	19·0	14	9	13	21	27	30
B16	15·2	11	13	13	13	15	18
B17	11·0	-	21	22	25	25	28
B18	4·6	27	-	37	43	46	44
B19	21·5	-	8	11	16	18	-
B20	30·5	15	17	14	20	-	-
B21	27·0	7	8	-	8	8	-

APPENDIX VIb (cont'd.)

Respiratory rate values (breaths per min) for the clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B22	12·5	-	36	27	24	30	-
B23	25·5	16	14	17	34	-	33
B24	40·0	13	12	13	14	16	18
B25	13·0	7	6	10	16	-	24
B26	20·0	21	25	36	36	28	-
B27	28·0	-	5	6	6	8	-
B28	8·0	26	32	40	52	37	-
B29	28·0	11	16	7	25	30	-

APPENDIX VId

<u>Respiratory rate values (breaths per min) for the clinical dogs in dorsal posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B30	13·5	54	59	58	63	60	64
B31	16·7	-	44	21	16	24	19
B32	33·5	12	17	11	13	17	26
B33	7·5	15	19	29	33	-	-
B34	5·0	-	52	47	45	46	51
B35	11·0	-	41	45	49	51	52
B36	33·0	-	14	16	23	21	26
B37	9·5	-	35	42	47	39	41
B38	11·5	-	10	38	44	50	52
B39	36·0	-	16	18	24	32	36

APPENDIX VIb (cont'd.)

<u>Respiratory rate values (breaths per min) for the clinical dogs in dorsal posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B40	28·0	24	32	33	34	36	37
B41	25·0	14	16	14	15	-	16
B42	26·4	9	18	15	19	23	-
B43	39·0	15	15	14	16	18	21
B44	28·5	24	5	22	35	41	32
B45	18·0	-	11	31	19	24	-
B46	26·0	13	16	30	20	22	24
B47	7·0	8	9	16	15	-	-
B48	17·8	38	41	50	56	60	-
B49	13·0	52	48	38	49	56	-
B50	28·0	-	12	11	23	-	-

APPENDIX VIc

Minute volume values (litres per min) of the clinical dogs in the left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B1	9·5	-	2·304	2·106	1·725	1·968	-
B2	39·0	4·950	4·740	3·600	3·950	5·400	5·880
B3	28·0	5·726	-	5·670	6·330	6·375	-
B4	15·3	1·200	2·403	2·772	-	-	-
B5	4·5	3·500	2·666	3·876	2·952	-	-
B6	28·0	1·248	1·948	2·772	3·810	-	-
B7	11·0	3·927	4·130	4·200	-	-	-
B8	9·9	1·116	2·006	1·848	3·078	3·630	3·900
B9	13·6	2·254	3·358	2·490	3·010	3·268	3·360
B10	8·5	1·600	2·400	3·124	3·036	-	-
B11	25·0	2·790	7·200	7·392	-	-	-
B12	28·0	2·652	3·000	-	5·208	5·775	-
B13	10·5	-	1·540	1·470	-	-	-

APPENDIX VIc

<u>Minute volume values (litres per min) of the clinical dogs in the right lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B14	9·0	2·55	3·15	4·67	4·76	-	-
B15	19·0	2·24	1·90	2·69	4·62	5·24	6·30
B16	15·2	2·90	3·13	2·60	2·27	3·36	3·56
B17	11·0	-	1·93	2·09	2·77	2·97	4·03
B18	4·6	2·08	-	2·70	3·18	2·90	3·19
B19	21·5	-	2·07	2·98	3·98	4·27	-
B20	30·5	6·15	5·49	5·81	5·08	-	-
B21	27·0	2·30	2·70	-	3·30	3·53	-

APPENDIX VIc (cont'd.)

Minute volume values (litres per min) of the clinical dogs in the right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B22	12·5	-	4·93	3·73	3·29	3·60	-
B23	25·5	4·45	4·20	4·28	5·78	-	5·35
B24	40·0	4·04	3·67	4·84	5·04	4·96	5·49
B25	13·0	1·69	1·58	2·55	3·78	-	5·04
B26	20·0	5·80	5·15	9·22	8·39	7·76	-
B27	28·0	-	1·08	1·40	1·34	1·90	-
B28	8·0	1·66	2·40	2·84	3·85	2·44	-
B29	28·0	1·80	3·30	2·13	4·45	5·46	-

APPENDIX VIc

Minute volume values (litres per min) of the clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B30	13·5	4·27	6·02	3·97	4·41	4·86	4·54
B31	16·7	-	4·62	2·58	2·11	3·12	2·77
B32	33·5	4·00	6·49	2·80	3·29	4·16	6·27
B33	7·5	0·40	0·95	1·25	2·18	-	-
B34	5·0	-	3·02	3·10	3·20	3·00	3·37
B35	11·0	-	5·08	5·27	4·90	5·36	5·77
B36	33·0	-	3·01	3·55	4·83	4·93	6·27
B37	9·5	-	3·57	3·99	4·14	4·29	4·30
B38	11·5	-	0·61	2·09	2·29	2·75	2·76
B39	36·0	-	3·30	4·30	5·88	6·24	7·38
B40	28·0	4·80	4·96	5·84	5·85	6·12	6·22

APPENDIX VIc (cont'd.)

Minute volume values (litres per min) of the clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B41	25·0	3·35	3·41	3·25	3·75	-	3·46
B42	26·4	2·88	2·09	3·33	4·08	5·18	-
B43	39·0	5·04	4·37	4·03	4·74	5·76	6·43
B44	28·5	6·48	1·80	5·52	6·61	6·76	6·30
B45	18·0	-	4·14	6·39	3·40	4·03	-
B46	26·0	4·03	4·50	6·12	4·40	4·75	4·94
B47	7·0	0·92	0·85	1·60	1·25	-	-
B48	17·8	3·16	2·99	3·50	3·70	3·84	-
B49	13·0	4·16	5·76	4·50	5·29	7·22	-
B50	28·0	-	3·71	3·15	6·39	-	-

APPENDIX VId

Pulse rates (beats per min) of clinical dogs in left lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B1	9·5	132	120	-	96	104	100
B2	39·0	180	160	156	124	120	112
B3	28·0	168	168	168	144	-	-
B4	15·3	-	156	148	144	136	128
B5	4·5	180	-	100	120	-	-
B6	28·0	168	-	160	148	132	120
B7	11·0	-	128	112	124	120	-
B8	9·9	168	184	-	-	-	-
B9	13·6	160	104	120	-	-	-
B10	8·5	156	148	132	-	-	-
B11	25·0	100	100	100	108	-	-
B12	28·0	120	130	136	-	-	-
B13	10·5	152	144	140	128	-	-

APPENDIX VId

<u>Pulse rates (beats per min) of clinical dogs in right lateral posture during anaesthesia.</u>

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B14	9·0	-	-	120	98	84	-
B15	19·0	200	160	152	136	-	-
B16	15·2	128	116	96	108	104	100
B17	11·0	-	164	140	136	132	128
B18	4·6	-	128	120	124	120	-
B19	21·5	148	124	128	-	120	-
B20	30·5	144	136	128	-	132	-
B21	27·0	-	-	160	148	132	-

APPENDIX VId (cont'd.)

Pulse rates (beats per min) of clinical dogs in right lateral posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B22	12·5	136	128	-	132	136	-
B23	25·5	120	110	-	100	-	-
B24	40·0	-	-	124	114	136	-
B25	13·0	-	-	140	136	136	-
B26	20·0	120	116	136	132	-	-
B27	28·0	136	124	104	112	108	-
B28	8·0	140	120	108	108	104	-
B29	28·0	148	136	112	108	108	116

APPENDIX VId

Pulse rates (beats per min) of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia 10 min	20 min	30 min	40 min	50 min	60 min
B30	13·5	124	136	124	110	-	-
B31	16·7	120	110	100	100	-	-
B32	33·5	-	148	160	144	-	-
B33	7·5	151	160	88	92	86	84
B34	5·0	120	120	142	-	-	-
B35	11·0	116	88	92	84	-	-
B36	33·0	-	108	120	120	120	120
B37	9·5	136	132	132	124	120	-
B38	11·5	124	116	108	100	-	-
B39	36·0	-	144	120	112	104	104
B40	28·0	180	164	160	126	126	128

APPENDIX VId (cont'd.)

Pulse rates (beats per min) of clinical dogs in dorsal posture during anaesthesia.

Case numbers	Body weight (kg)	Duration of Anaesthesia					
		10 min	20 min	30 min	40 min	50 min	60 min
B41	25·0	160	160	152	152	-	-
B42	26·4	170	152	144	124	-	-
B43	39·0	-	120	140	132	100	132
B44	28·5	168	160	120	-	-	-
B45	18·0	144	128	124	124	-	-
B46	26·0	-	-	160	158	160	124
B47	7·0	-	128	144	120	120	112
B48	17·8	160	120	140	120	-	-
B49	13·0	-	140	100	-	-	-
B50	28·0	152	148	140	-	-	-

APPENDIX VIIa

<u>Tidal volume values of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.</u>

Dog number	Body weight (kg)	Left lateral				Right lateral				Dorsal			
		15 min	30 min	45 min	60 min	15 min	30 min	45 min	60 min	15 min	30 min	45 min	60 min
C1	16·9	192	202	197	184	204	213	205	180	169	200	215	218
C2	17·2	258	250	227	182	251	218	176	200	228	132	193	219
C3	13·1	156	129	164	172	142	192	168	177	141	69	190	263
C4	13·7	172	233	227	199	247	185	177	181	242	196	193	182
C5	11·0	190	130	140	156	233	258	278	194	214	107	190	175
C6	14·2	172	173	177	193	166	185	175	186	183	192	185	191
C7	11·1	150	137	150	172	191	183	163	181	165	168	192	152
C8	12·0	154	141	155	141	183	156	170	164	165	189	163	159

APPENDIX VIIb

<u>Respiratory rate values of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.</u>

Dog number	Body weight (kg)	Left lateral 15 min	30 min	45 min	60 min	Right lateral 15 min	30 min	45 min	60 min	Dorsal 15 min	30 min	45 min	60 min
C1	16·9	13	16	22	24	12	12	21	25	16	20	17	17
C2	17·2	12	15	19	25	7	20	32	25	8	17	18	19
C3	13·1	20	36	30	25	34	30	28	22	22	20	18	16
C4	13·7	18	11	14	24	6	15	21	20	6	11	12	17
C5	11·0	20	33	44	33	6	6	9	7	7	7	10	14
C6	14·2	25	24	26	23	16	15	18	17	12	13	16	14
C7	11·1	12	17	22	18	12	12	16	15	8	12	13	18
C8	12·0	27	42	37	49	21	29	23	33	15	26	32	40

APPENDIX VIIc

Minute volume values of the experimental dogs in left and right lateral and dorsal posture during 60 minutes of anaesthesia.

Dog number	Body weight (kg)	Left lateral 15 min	30 min	45 min	60 min	Right lateral 15 min	30 min	45 min	60 min	Dorsal 15 min	30 min	45 min	60 min
C1	16·9	2·41	3·23	4·34	4·42	2·45	2·55	4·30	4·51	2·70	4·00	3·65	3·70
C2	17·2	3·10	3·80	4·32	4·54	1·76	4·35	5·62	4·99	1·82	2·25	3·47	4·16
C3	13·1	3·11	3·88	4·92	4·30	4·81	5·77	4·71	3·90	3·10	5·75	3·42	4·20
C4	13·7	3·10	2·56	3·18	4·77	1·48	2·77	3·72	3·62	1·45	2·16	2·31	3·10
C5	11·0	3·80	4·28	6·15	5·15	1·40	1·55	2·50	1·36	1·50	1·45	1·90	2·45
C6	14·2	4·29	4·15	4·60	4·43	2·66	2·77	3·15	3·16	2·20	2·49	2·96	2·68
C7	11·1	1·80	2·33	3·31	3·10	2·29	2·20	2·60	2·72	1·32	2·02	2·50	2·74
C8	12·0	4·16	5·94	5·73	6·90	3·84	4·51	3·90	5·40	2·47	4·90	5·20	6·36

APPENDIX VIId

Pulse rate values of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.

Dog number	Body weight (kg)	Left lateral 15 min	30 min	45 min	60 min	Right lateral 15 min	30 min	45 min	60 min	Dorsal 15 min	30 min	45 min	60 min
C1	16·9	120	92	96	92	100	78	76	72	120	108	94	84
C2	17·2	152	148	140	132	136	124	118	116	160	152	142	128
C3	13·1	124	140	128	100	128	120	116	108	144	128	120	100
C4	13·7	136	120	124	112	132	124	120	116	116	98	92	88
C5	11·0	160	146	140	132	150	144	132	120	144	120	140	120
C6	14·2	152	140	136	120	132	128	124	120	108	94	88	86
C7	11·1	108	108	108	100	124	116	108	98	148	156	152	132
C8	12·0	152	148	120	112	144	128	120	120	136	128	132	136

APPENDIX VIIIa

P_aCO_2 values of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.

Dog number	Body weight (kg)	Left lateral Control	Left lateral Anaesthesia 30 min	Left lateral Anaesthesia 60 min	Right lateral Control	Right lateral Anaesthesia 30 min	Right lateral Anaesthesia 60 min	Dorsal Control	Dorsal Anaesthesia 30 min	Dorsal Anaesthesia 60 min
C1	16·9	34·0	52·0	77·0	36·5	46·0	47·0	42·0	60·0	58·5
C2	17·2	34·9	-	43·5	38·0	39·5	50·0	33·5	51·0	71·0
C3	13·1	34·5	55·5	62·5	39·8	50·5	60·0	39·4	54·4	58·4
C4	13·7	30·0	54·0	-	33·8	55·0	58·5	31·4	48·0	49·0
C5	11·0	36·0	47·0	48·0	40·0	86·0	75·0	36·0	66·0	63·5
C6	14·2	40·0	52·5	52·5	40·0	55·5	61·5	40·0	56·5	62·0
C7	11·1	43·0	48·0	50·5	31·5	49·0	45·0	37·0	55·0	52·2
C8	12·0	35·0	50·0	53·0	33·5	55·5	57·0	33·5	64·0	57·5

APPENDIX VIIIb

pH values of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.

Dog number	Body weight (kg)	Left lateral Control	Left lateral Anaesthesia 30 min	Left lateral Anaesthesia 60 min	Right lateral Control	Right lateral Anaesthesia 30 min	Right lateral Anaesthesia 60 min	Dorsal Control	Dorsal Anaesthesia 30 min	Dorsal Anaesthesia 60 min
C1	16·9	7·350	7·260	7·210	7·401	7·290	7·190	7·330	7·215	7·200
C2	17·2	7·380	–	7·290	7·360	7·250	7·190	7·353	7·185	7·160
C3	13·1	7·358	7·255	7·249	7·347	7·257	7·208	7·380	7·250	7·224
C4	13·7	7·392	7·230	–	7·329	7·251	7·260	7·430	7·290	7·270
C5	11·0	7·411	7·254	7·240	7·420	7·320	7·190	7·350	7·200	7·180
C6	14·2	7·349	7·230	7·241	7·436	7·257	7·259	7·356	7·262	7·238
C7	11·1	7·357	7·305	7·290	7·451	7·358	7·346	7·362	7·260	7·262
C8	12·0	7·370	7·291	7·275	7·442	7·298	7·267	7·408	7·246	7·236

APPENDIX VIIIc

P_aO_2 values of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.

Dog number	Body weight (kg)	Left lateral Control	Left lateral Anaesthesia 30 min	Left lateral Anaesthesia 60 min	Right lateral Control	Right lateral Anaesthesia 30 min	Right lateral Anaesthesia 60 min	Dorsal Control	Dorsal Anaesthesia 30 min	Dorsal Anaesthesia 60 min
C1	16·9	126	240	250	99	320	310	135	215	232
C2	17·2	75	230	230	110	210	235	115	170	220
C3	13·1	101	250	250	99	239	325	102	230	250
C4	13·7	99	200	250	-	235	260	94	219	235
C5	11·0	105	231	230	92	195	230	103	215	240
C6	14·2	80	210	225	101	216	195	-	230	240
C7	11·1	127	250	275	122	225	250	116	230	252
C8	12·0	133	218	240	90	240	225	101	230	259

APPENDIX VIIId

<u>Standard bicarbonate values (mEq/l) of the experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.</u>

		Left lateral			Right lateral			Dorsal		
			Anaesthesia			Anaesthesia			Anaesthesia	
Dog number	Body weight (kg)	Control	30 min	60 min	Control	30 min	60 min	Control	30 min	60 min
C1	16·9	18·0	22·0	22·5	21·5	18·5	16·0	21·2	20·5	17 0
C2	17·2	21·2	20·5	20·0	21·0	16·0	18·0	20·0	17·0	20·0
C3	13·1	20·5	21·9	22·3	23·0	21·0	19·5	23·0	22·7	22·5
C4	13·7	20·3	19·9	-	24·0	21·5	21·5	24·0	21·5	20·5
C5	11·0	22·5	19·5	17·8	25·5	19·5	20·5	19·7	20·5	20·0
C6	14·2	21·5	20·1	20·0	25·0	24·0	23·2	21·0	22·1	23·0
C7	11·1	23·0	22·5	22·5	23·0	26·0	23·0	23·5	22·2	21·5
C8	12·0	20·5	22·0	22·4	24·0	23·7	23·0	22·5	21·2	22·0

APPENDIX IX

Haemoglobin values of experimental dogs in left and right lateral and dorsal postures during 60 minutes of anaesthesia.

		Left Lateral			Right Lateral			Dorsal		
			Anaesthesia			Anaesthesia			Anaesthesia	
Dog number	Body weight (kg)	Control	30 min	60 min	Control	30 min	60 min	Control	30 min	60 min
1	13·1	16·67	-	13·67	18·15	13·23	14·61	17·04	14·36	14·60
2	13·7	15·06	14·74	14·74	14·92	13·38	11·23	15·70	14·81	12·90
3	11·0	16·98	13·06	14·37	-	13·43	11·57	14·12	12·24	12·24
4	14·2	15·35	14·37	12·40	16·00	14·49	12·07	13·90	12·90	11·90
5	11·1	16·38	15·10	14·81	14·29	14·53	13·04	15·07	14·62	12·00
6	12·0	18·51	17·70	15·90	18·90	18·10	16·15	19·07	18·47	16·57